The Portsmouth Papers

42

Published by Portsmouth City Council
Civic Offices
Guildhall Square
Portsmouth PO1 2AL

No. 42 March 1985

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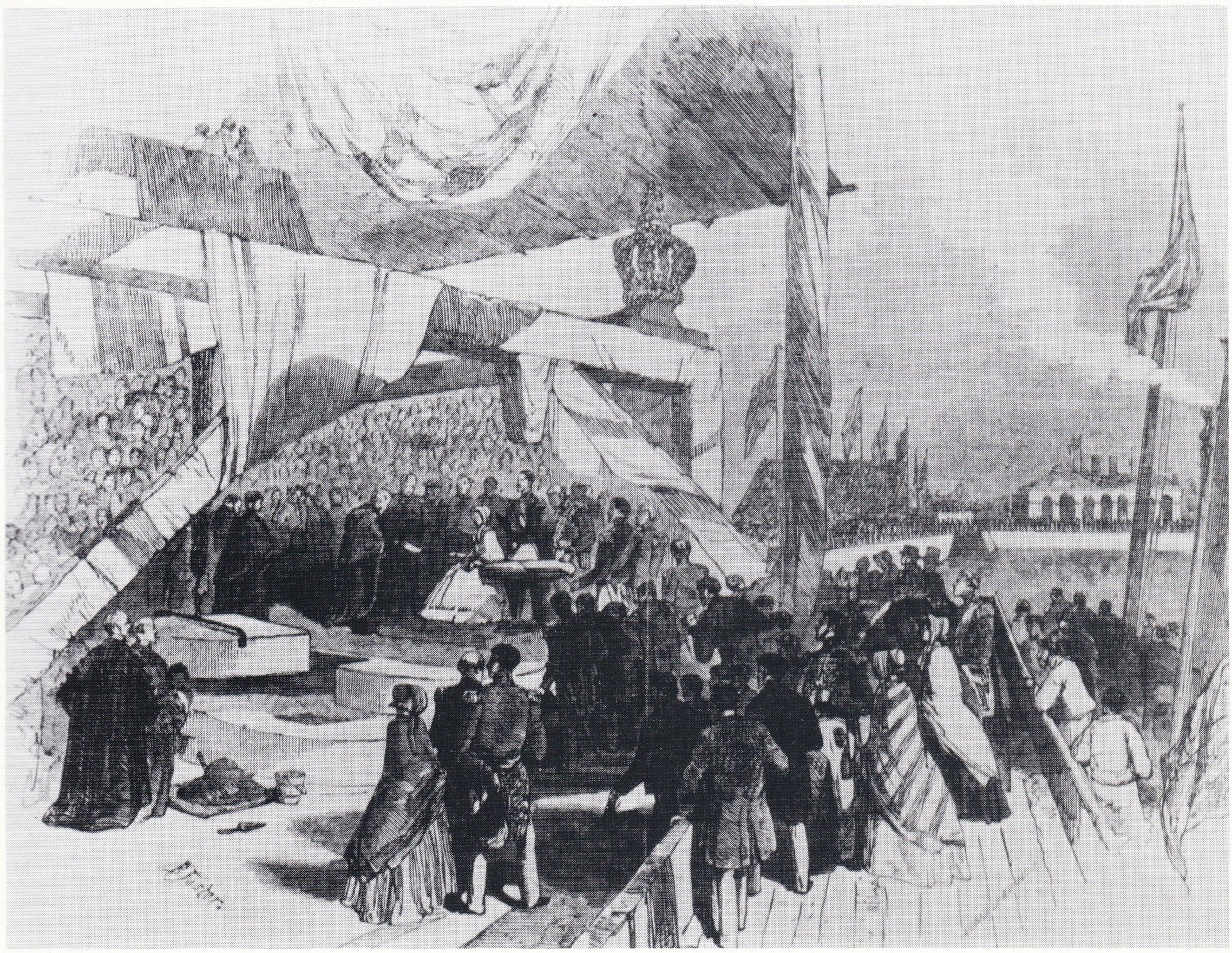

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The PORTSMOUTH PAPERS *are published under the auspices of the Libraries, Museums and Arts Historical Publications Sub-Committee of the Portsmouth City Council, Civic Offices, Guildhall Square, Portsmouth, PO1 2AL*

Issue Number 42 March 1985

ISBN 0 901559 63 6

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Cover:
Opening of the New Steam Basin at Portsmouth
25 May 1848
R.N. Museum, Portsmouth

Printed by Eyre & Spottiswoode Limited at Grosvenor Press Portsmouth

STEAM WOODEN WARSHIP BUILDING IN PORTSMOUTH DOCKYARD 1832–52

E. A. M. Laing

The Start of Steam Warship Building at Portsmouth Dockyard 1832–41

A Return of the Number of Vessels propelled by Steam published by the Navy Office on 27 October 1831 listed at that time, twelve ships 'employed', two 'built', and five 'building',[1] making a total of nineteen ships 'under the Orders of the Government'. Of those employed, seven were noted specifically as on the packet service, a non-military organisation on behalf of the Post Office, but manned by the Royal Navy. If this seems a small total, it is worth recalling that, although the Industrial Revolution is usually dated as having begun about 1750, its effects were slow to spread to maritime purposes. An historian of industrial archaeology has written

> In the early years of its development, the steam engine was regarded in the industrial field as a rather expensive and unreliable substitute for water power. As late as the middle of the nineteenth century mines were provided with water-driven pumps whenever a suitable supply could be exploited . . .[2]

A year after the above-quoted Return was published, in 1832, the Navy Board, responsible since the seventeenth century for the running of the Royal Dockyards, was abolished (2 W IV Cap 40),[3] and Sir William Symonds became Surveyor of the Navy, responsible for the construction of ships. He is described by Christopher Lloyd[4] as a 'distinguished naval architect' though this is disputable. So far as these developments affected Portsmouth, it may be remarked that none of the twenty steamers acquired for, or built by the Royal Navy had been constructed there.[5] Of the naval dockyards, Deptford, Woolwich, Chatham, Sheerness, Plymouth and Pembroke preceded it as builders of steam warships. So, of the hulls launched to 1832 for the Royal Navy, fourteen were built 'on the River', i.e. the Thames and Medway.

However, by October 1832, it appears that the authorities were taking a closer look at Portsmouth's possibilities in the Steam Age, for, according to a local newspaper report[6]

> Sir Edward Banks [1769?–1835][7] deputed by the Board of Admiralty Surveyed the whole of the Docks in this Yard yesterday, to make an estimate of the expense that would attend the widening of the docks which is contemplated.

Presumably the reason why the bulk of early steam warship building took place on the Thames was that most of the pioneer marine engineering works were concentrated in the London area. It would have been most practical for the naval dockyards in the vicinity to build the early steam warships with the capital so accessible by water from the engine builders' works in the pre-railway era.

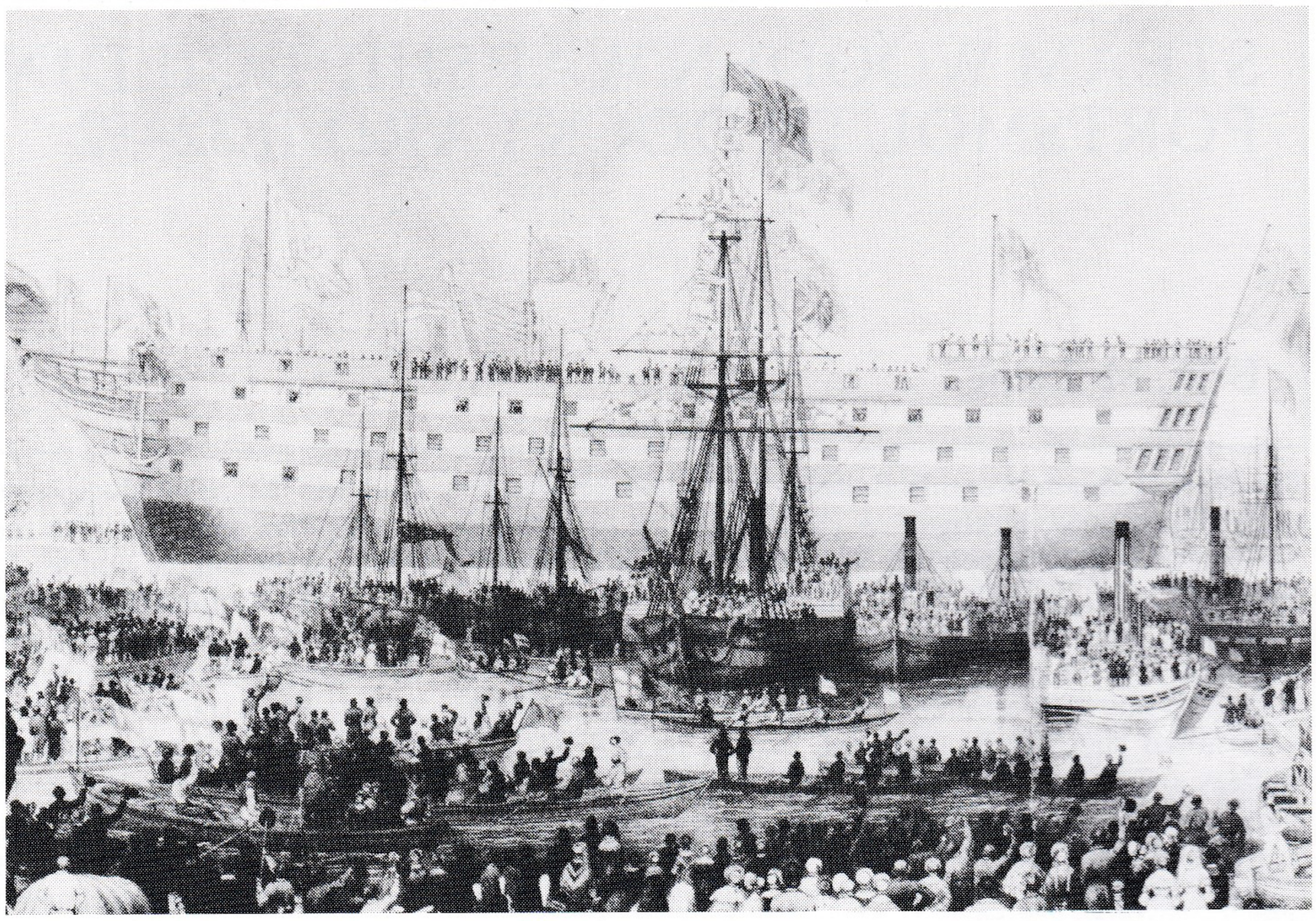
That Portsmouth was still only in the process of importing marine engineering expertise we may see from a letter the Admiral Superintendent, Rear-Admiral Sir Frederick L. Maitland (1777–1839)[8], wrote in 1833 to the First Secretary of the Admiralty, the Hon. George Elliot (1784–1863)[9], to inform him that

> the Master Shipwright has stated that it will be necessary to procure the Millwrights who must be Engine makers . . . from London as that description of workmen are not to be procured in the neighbourhood and he has suggested that Messrs Maudslay[10] be applied to on the subject.[11]

It therefore seems evident that Portsmouth, in the dawn of the marine steam engine age, did not have the technical skills other than those of shipwright or blacksmith. Indeed, an historian of nineteenth century industries in Portsmouth has shown[12] that the town was 'lacking an engineering tradition'. A table of 'Shipbuilding and Allied Trades in Portsmouth . . .'[13] lists for 1841 only 21 'engineers' out of a total of 1749 employed. The same author hints at a lack of innovative or entrepreneurial talents on the island, and observes

> a notable absence of large houses and surrounding estates so frequently found on the fringes of industrial towns fashioned in the nineteenth century; there are no parks created from gardens of the rich, nor a university endowed by the philanthropically-minded industrialists.[14]

Although early engineers did not therefore abound in Portsmouth in the beginning of the 1830s, we can nonetheless find evidence of one such craftsman who went on to achieve recognition in his profession, emerging from the anonymity of Dockyard tradesmen, at about this period. Such a man was Robert Taplin. He was described as 'a Leading Man of Millwrights in the Yard', the word 'engineer' not then being applied to his trade. He was recommended on 9 October 1833 to succeed his superannuated predecessor.[15] The Admiral described him as 'a man of good character', and considered in every way competent to the situation'. By 1841 Taplin described himself[16] as an 'Engineer', and we may trace his development later in this paper. That the Dockyard previous to 1833 had difficulty in recruiting technically-trained personnel is evident from a letter in which the Secretary of the Admiralty[17] was asked for assistance in repairing the Engines at the Metal



Mills, requesting permission for '16 Millwrights who must be engine makers to commence with this work' as otherwise 'the manufacture of Iron and Copper must stand still during the repair of the Engine'.[18]

By the beginning of 1834, the official returns[19] recorded nineteen steam vessels built or building, for the Royal Navy. Portsmouth's first war steamer, *Hermes*, later described as a Paddle Wheel Sloop, was mentioned on 21 May of that year. The Admiral Superintendent confirmed on that day that the iron work for her diagonal frames 'can be furnished at this Yard . . . at the rate of £5. 5*s*. 0*d*. per Ton'. He explained that for the larger *Royal Frederick*, then slowly building as a 110-gun sailing First Rate[20], there were no 'Rolls equal to produce Iron-work of such dimensions'. Technically innovative work for the Dockyard was referred to again in the correspondence later in the year, on 8 December, when another Minute recorded the return to London of 'the drawings, etc., in preparing the Paddle beams of the Hermes S[team] V[essel]. The drawings alluded to were forwarded by Coach this evening.' (Despite the transmission of mail and packages to London by coach at this period, the speed of communication, judging by the promptness of replies, is noteworthy.) Even by the close of the year, there was still little in the way of steam warships to be seen at Portsmouth. In a letter of 9 December 1834, Maitland reported to the Admiralty on 'a strict survey . . . taken of the Steam Boilers and Machinery of the Salamander the only Steam Vessel laying [*sic*] at this port . . .'[21]

Slow progress was being made, in the meantime, with the construction of the *Hermes*. The Admiral Superintendent wrote on 10 December 1834 that he had four gangs each working on her and the *Royal Frederick*, plus another three on the *Inconstant*, a sailing Fifth Rate of 36 guns launched nearly two years later.[22] He proposed to divert 'a gang from each of these Ships' in addition to '. . . hired Masons and Plumbers' on to building works ashore.[23] Presumably with the country at peace, and an adequate fleet in being, there was little pressure on the ship-building programme; such delays could therefore be tolerated without harm to the Royal Navy's fighting capability. At the beginning of the following year, the shipwrights reported difficulty 'in fixing the King Post for framing the Paddle Box . . . [of the] Hermes etc.' and requested directions from the Surveyor of the Navy.[24] Not only did the shipwrights have to contend with new problems affecting the building of the *Hermes* as exemplified by the design of her paddle beams, but they were tested in other ways. Thus on 3 February 1835 they submitted 'A plan for Steering the Hermes by a simple but efficient Machinery fitted abaft the Rudder', and sent it off to London by the evening coach.[25] When the *Hermes* was launched on 26 June 1835,[26] she became the first steam warship designed as such to enter the water at Portsmouth. It is estimated that she took about two years to build. The Dockyard's involvement in the fitting of her means of propusion cannot be seen as other than marginal. There is no evidence either that its hull-building activities were particularly affected by the ship's novel aspects, other than through its contribution to the 'plan for steering' referred to above, and the problems over the framing of the paddle boxes. The ship safely launched, despite a day of 'Winds WSW Fresh gales and Heavy squalls and rain',[27] the Dockyard Officers were apparently satisfied with her.

They were concerned, however, over their next steam vessel, *Volcano*, launched almost exactly a year later, on 29 June 1836. A letter was sent off to the Surveyor of the Navy 'Relative to her light displacement . . . taken from her original drawings' on 7 July.[28] This would appear to indicate a discrepancy between the design calculations and the proportions of the finished ship.

By the end of 1836, word of an extension of the Dockyard seemed to have filtered through to the Press. *The Hampshire Telegraph* on 26 December 1836[29] carried an

Launch of an unnamed 110-gun ship at Portsmouth, circa 1832
Portsmouth City Museum

account of a suggestion to enlarge the Dockyard by enclosing the Hard at Portsea. This was a wide-ranging proposal, the cost of which, the newspaper estimated 'cannot be computed at less than five millions of pounds'. Nonetheless, the report did foreshadow a technological development of importance for the Victorian Navy at Portsmouth, the building of the Steam Factory, but that was not to come about for another eleven years.

When a steam vessel had been launched, the Dockyard was by no means as finished with her as it might have been with a sailing ship. References to technical or innovative problems with *Volcano* continue to occur in the Dockyard correspondence with the Admiralty. It was necessary to take steps on 'the Copper Boilers of His Majesty's Steam Vessel Volcano to prevent the rapid destruction of the Copper if it is not defended from the action of the Salt Water'.[30] The 'action of the Salt Water' mentioned arose from its use in the boilers of early steam ships.[31] Maitland wrote to Charles Wood[32] reporting the supply of some cimisic [*sic*] from Woolwich Yard 'for the purpose of being placed at the bottom of . . .' *Volcano*'s boilers. Bricklayers were employed on this work. According to an historian of naval and marine engineering,[33] *Volcano* was the first warship for which Seaward provided the engines. It was also he who arranged for the above-mentioned substance to be supplied to Portsmouth. Having left Portsmouth, *Volcano* was ordered back from Falmouth to have her defects remedied, in April 1837,[34] 'Mr Seaward . . . being directed . . . to inspect the boilers, a careful Survey and a report on them is to be made for their Lordships' information'.[35] There was then doubt as to whether *Volcano* was to be repaired at Portsmouth, or in Seaward's Works. Maitland requested precise orders as to 'whether the Millwrights here are to repair the boiler, or the vessel proceed to Woolwich' for Seaward's men to work on her.[36]

Seaward had apparently told 'Mr Taplin the conductor of the Wood Mills and Millwrights' department that he had a plan of his own which he intended to send down to prevent Water being blown off too low in the Boilers of the Volcano Steam Vessel'.[37] The main defect in the *Volcano*'s boilers was located 'in one of the Fireplaces of the Starboard Boilers where the two side plates are so entirely burnt as to render it necessary they should be renewed'.[38] The 'accident appears to have been occasioned by the neglect of the 3rd. Engineer allowing too large a quantity of water to escape from the Boiler through the blowout cocks'.[39] The incident illustrates the lack of adequate instrumentation on early marine steam engines. Nursing these would require a combination of experience and the pragmatic approach which a junior engineer might hardly have had time to acquire.[40] The estimate of the cost of repair to *Volcano*'s boilers came to £31. 0*s*. 0*d*.[41] As a result of the incident, a method of 'blowing out Boilers', was devised by Peter Ewart (1767–1842), appointed Chief Engineer and Inspector of Machinery at Woolwich Dockyard in 1835.[42] Seaward arrived at Portsmouth 'with Pipes and Cocks which are considered as an improvement on the present mode . . . and he requested to be allowed to fit them in the Volcano's Boilers at his own expense . . .', Maitland reported on 15 April 1837.[43] In such a way did the running of early marine steam engines develop, through practical problems and the *ad hoc* solutions devised to solve them.

Although the Admiralty had decided to build its first screw-driven warship in May 1840, Portsmouth's first purpose-built vessel with this means of propulsion was not to be launched for another six years. We may therefore leave this development aside for a while to follow the Dockyard's continuing programme of paddle wheel warship construction. In 1840 it was working on its next ship of this type, the *Driver*, of 1058 tons, classed as a sloop. Maitland had died on 30 November 1839, and his successor as Admiral Superintendent was Rear-Admiral the Hon. Duncombe Pleydell Bouverie (1780–1850).[44] He received approval on 6 July 1840 from the Admiralty for the use of '30 pairs of Sawyers being employed exclusively in cutting materials for the 'Driver' for a sum of £269 14*s*. 7*d*. and at unlimited Earnings'. The sawyers had 'cut a greater proportion of African [oak]' than for *Stromboli* (see below) and so exceeded the amount budgeted for by £3 13*s*. 6*d*. Bouverie was allowed to pay them this extra amount, but a rap on the knuckles from their Lordships of the Admiralty for allowing it to happen was conveyed by 'Your very humble Servant' Sir John Barrow.[45] *Stromboli* had been launched on 27 August 1839. Her Engineer, George Clements, had to go to 'Woolwich raising Stokers for that Vessel'. The Accountant General of the Navy, on 1 September 1840, authorised the Admiral Superintendent to pay Clements his expenses for this mission, £2 19*s*. 6*d*. 'charging the same under the head of service "Raising Men"'.[46] It is of interest that Portsmouth could not find the stokers needed for this small vessel, so the men for the unseamanlike business for firing her had to be found in the Thames Estuary area. That locality's earlier experience with steamers would naturally render it a more fruitful source of recruitment of engine-room personnel, since at the time, the skill of firing steam ships was not yet even in the process of being acquired in Portsmouth. This is all the more surprising, since Penn[47] in an unattributed quotation, but dated as 1840, mentioned

> The manning of HMS *Stromboli* has been effected within a month, and it only shows what a whimsical being the sailor is, for such ships as the *Rodney* and

Vanguard cannot get men, while for steamers, small craft and troopships, men jostle each other and crowd to get on board and enter.

The quotation refers specifically to sailors, and evidently the difficulty in finding stokers in the Portsmouth area is evidence of the early unpopularity of that employment.

In October 1840 the Admiralty decided to fit the *Driver* with mechanical means of fire-fighting, so on the fourteenth of that month, the Storekeeper General informed the Admiral Superintendent 'that Mr Downton has [*sic*][48] been desired to deliver and fit on board the "Driver" Steam Vessel, at your Yard, two of his 7ins three lift Patent[49] Fire Engine Pumps . . .'. The cost of this equipment was £318, and the Officers were directed to install it.[50] As for ship construction generally, however, at this period, in spite of the introduction of such innovative features as Downton's pumps, the impression from a reading of the correspondence, is one of a leisurely pace of advance, up to the early 1840s. However, this was soon to alter; for instance on 20 October 1840, Barrow wrote to the Admiral Superintendent, on the instructions of 'My Lords Commissioners of the Admiralty to signify their direction to you to take such steps as will insure the Driver being completed so as to be at the Engineers in the River on the 1st of January next'.[51] The Admiralty now began to put pressure on for the speedy completion of the *Driver*. Regarding the number of shipwrights allocated to her, the Admiral having made certain proposals on 31 October, Barrow replied on 3 November

> every exertion is to be used to carry the same into effect as the days are now so short that no extra hours can be obtained.

In spite of their desire to minimise delays, the Admiralty was not yet prepared to allow any work incentives to the labour force, and the familiar note of caution arises again, as Barrow's letter continued

> [My Lords] see no object in allowing the men to work by Job and Task,[52] as with proper vigilance there appears no reason why these ships should not be finished by the time fixed upon.
>
> I am desired by their Lordships to call your most particular attention to this subject *as it is of the utmost importance that no delay should take place*.[53]

With only a month to go before the *Driver* was due to be completed, Bouverie had asked to be allowed to direct the whole of his work-force of caulkers to her, and that therefore 'the caulking of the *St Vincent*[54] must of necessity be deferred'. However, Barrow was adamant, and wrote to the Admiral Superintendent on 1 December that 'their Lordships are desirous to have the St Vincent finished without delay'.[55] Again, the Shipwright Officers pleaded for the dead-line of the *Driver* to be put back by five days, and were once more turned down, via Barrow, on 3 December, thus:

> . . . I am commanded by my Lords to acquaint you that they cannot sanction the postponement of the "Driver" and that they expect nothing will prevent her being completed by the 21st Inst[ant] as originally intended . . .[56]

Nevertheless, some relief was at hand, and on 8 December their Lordships reversed their previous attitude to 'task and job', for on that day[57] Barrow conveyed their approval for caulkers to be employed on that basis on the *Driver*. This appears to have had the desired effect, and the ship is recorded[58] as launched on 24 December 1840. Two days earlier, Barrow had written in a letter to Bouverie[59] that *Driver* was

> To be taken into Dock as soon as she is launched for the purpose of having her Cleets[60] etc removed from the Bottom and the Cocks fitted with the necessary platforms in the Hold under the Superintendence of Messrs Seaward's Foreman who will proceed to Portsmouth on Monday to give the proper instructions for these fittings and providing the materials for lining the Boilers and to be sent round in the Vessel to prevent delay on her arrival at the Contractors.
>
> She is *not*[61] to be Coppered until her return to Portsmouth for completion and fitting for Sea; and a trustworthy Carpenter is to be sent in her to take charge of the Vessel and Stores.

As will be seen from the preceding paragraph, the preparation of a steam warship for sea entailed special procedures, so the Admiralty had to amend some of its systems. The Storekeeper-General, the Hon. Robert Dundas,[62] informed the Admiral Superintendent that the Ledger of Receipts and Issues would be altered to take into account the growing number of steamers in the Royal Navy

> observing that articles for the use of steam vessels and which are likely to be required have been introduced in their places in regard to alphabetical order . . . a ledger will be provided comprising not only Engineers Stores but Steam Engines, Boilers, Paddle wheels etc. . . .[63]

Henry Maudslay (1792–1864)
Marine Engine Builder
The Science Museum

for the use of all yards.

Whilst the *Driver* was with Seaward, Bouverie received from Barrow a letter dated 1 February 1841, forwarded from the engine builders, complaining of 'the mode in which the Paddle Beams of [the ship] have been secured'. He received their Lordships 'direction to . . . call upon the Officers to report how they came to be so inefficiently fitted and to desire them to see that proper security is given to Paddle Beams in future'.[64] Clearly, although the *Driver* was the third paddle wheel steam warship built at Portsmouth, her shipwrights, who, as we have seen, were responsible for the engine-room components referred to, had not yet fully come to terms with this new aspect of their work. No doubt they were still understandably unfamiliar with the strains put upon their timber-work by the force of steam power. There is no further reference in the correspondence to the *Driver* until the summer of 1841, by which time she was back at Portsmouth with her engines installed. On 7 July, Bouverie was informed by Barrow that, for the fitting of 'the platform on the Engine Room'

> Messrs Seaward will forward the Materials and Workmen forthwith for the performance of the work, in the execution of which the Officers are to render any necessary assistance.[65]

It is therefore apparent that at this stage the Dockyard's role in matters concerning the engine rooms of ships was still of an ancillary nature. However, while the part that Portsmouth Dockyard played in the development of the early steam navy was as yet a relatively minor one, experience had been gained, and the size of steamers had increased steadily with each new vessel built. Put into wider context, it should be remembered that two steam wooden warships (though not Portsmouth-built) had already seen active service on the coast of Syria, in 1840.[66] These were of a class generically known as frigates, or steam-, or paddle-wheel frigates, although other classifications were used for this type at different stages of their careers, because they did not fulfil the accepted definition of the term.[67] Such early nomenclature was employed for this class of war steamer of over 1,000 tons BM[68] in 1837.[69] The first of the type to be laid down at Portsmouth was the *Firebrand*.[70]

The next steam warship in the line of succession now a-building in 1841 at Portsmouth Dockyard, however, was the *Thunderbolt*. On 29 September of that year the Yard was notified that

> Mr. Napier's Agent Mr. A. Gordon will this week proceed to Portsmouth with the necessary measurements and directions for setting off the Stations of the Bolts, Cocks and Pipes on the Sleepers of the "Thunderbolt's" engines.[71]

This was the first reference to a new factor in shipbuilding and marine engineering, namely a sign of a shift in these activities from 'the River', northwards, in this particular case, to Clydeside. Robert Napier 'began business as a marine engineer in Glasgow in the 1820's'.[72] It would be, perhaps, another sixty years before the Clyde and the North-East of England reached their peak in this field, but in the meantime the *Thunderbolt* was to incorporate another innovation of the period, and one to which the Dockyard's ancient skill of boat-building was no doubt well-suited to contribute. This was the fitting of the 'paddle-box boat'. An up-turned open boat was laid over the otherwise exposed tops of the paddle-boxes, doubling as cover and lifeboat. On 14 October 1841 Barrow wrote[73] conveying their Lordships' instructions that the *Thunderbolt* was to be equipped with 'Captain Smith's Paddle Box Boats'.[74] Two weeks later it was decided to fit her for carrying the same armament as the *Driver*.[75] That plans for the building of this ship were still in a state of flux, is reflected in a note from the Surveyor in the same month, asking Bouverie to 'suspend the fitting of the Thunderbolt' until new plans for the installation of her magazines could be sent.[76]

By this time it was nearly the end of 1841. The decade now being entered was to see many changes in the design

and concept of the steam warship, principally in the acceptance of the screw as a means of propulsion. For Portsmouth, the most significant development was to be the building of the Steam Factory and the concomitant enlargement of the Dockyard. Portsmouth's new facilities in the Steam Factory would terminate its dependence on Woolwich for the servicing of marine engines and provide it with local resources for machinery maintenance, refitting and the manufacture of spare parts. As further evidence of the pace of change, in four years' time, the last of the classic wooden sailing First Rates from the Dockyard would be launched, and even these, *Prince of Wales* and *Marlborough*, would finish their careers as steam vessels. Presumably the Admiralty had recognised the potential possessed by steam power, and foresaw the decline of the sailing warship, when Barrow, in a Circular of 5 October 1841[77] asked for stocks to be checked 'without disturbing the stacks . . . of the quantity of timber fit for the construction of line of Battleships and large Frigates now remaining in the Yard'.

Start of Works on the New Steam Basin, 1841–44

We have seen that the introduction of steam propulsion into the wooden hulls of pre- and early-Victorian warships was a tentative and gradual process. By its pragmatic approach, despite some inevitable problems of adjustment, the Portsmouth Dockyard shipbuilding organisation was able to cope, with the help it received from outside. This fundamental change in the method of propulsion came during a period which was the 'dark age' in the history of the Royal Navy, falling as it does between the end of the French Wars, and the outbreak of the Crimean War. In trying to throw light on this neglected period, so far as Portsmouth is concerned, we continue by considering developments in the 1840's.

According to Bouverie, the *Thunderbolt* was to be launched on 13 January 1842, and this was approved by their Lordships of the Admiralty on 29 December 1841.[78] Another steam warship building in the Dockyard at this time was the *Scourge*.[79] Some detailed instructions about the work to be carried out on her were sent by the Surveyor, Sir William Symonds, on 6 January 1842[80]

> . . . the Main Deck Beams [supporting ?] the guns are to be converted from African Timber or English oak and those abaft if possible to be in one piece and . . . care is to be observed in the security of them, also the Shelf knees etc. to the vessel's sides.

This is evidence of the recognition of the particular need for the inherent strength of this class of vessel; we shall see below further corroboration of this concern in experiments as to how these ships responded to the firing of the armament fitted in them. The *Thunderbolt* had by now reached a stage sufficiently advanced for Barrow to inform the Admiral Superintendent just under a week before her launch that

Far left – *Frederick Lewis Maitland (1776–1839)*
R.N. Musuem, Portsmouth

Centre – *Sir Francis Pettit Smith (1808–74)*
The Science Musuem

Right – *John Ericsson (1803–1889)*
The Science Museum

> Their Lordships . . . have desired Mr. Napier to send proper persons immediately to Portsmouth to fit the Pipes etc. through the bottom of the Thunderbolt. She is to be prepared for being completed for commission on her return from Glasgow after her Engines are on board previous to which her decks are to be payed over[81] for protection against the weather; and she is to remain on the Slip until the Pipes through the bottom are fitted and not to be coppered until her return[82]

It was subsequently decided to dock her after launching 'to have the Engine Pipes fitted'.[83] Her launch duly took place on 13 January 1842.[84] We have seen that *Thunderbolt* was to be fitted with paddle box boats. On 26 January, Barrow addressed a circular to the Dockyards on the detailed specifications for these, recommended by 'The Committee of Shipwrights assembled at Woolwich'. The

> Boats . . . fitted over the Paddle Boxes of Steam Vessels on Captain Smith's Plan, to be built of two thicknesses of plank with a layer of felt between.

Barrow passed on their Lordships' instructions 'to signify their direction to you to cause Boats of this description to be built for any Steam Vessels building or in future ordered to be so'.[85]

The Admiralty's check on stocks of timber suitable for sailing line-of-battleships and frigate building, in the autumn of 1841, was now followed by similar orders for a stock-take on the specialized timber used by the Steam Navy as well. On 2 February 1842 the Surveyor wrote requesting

> . . . a report immediately on the quantity of Timber actually in store, that is convertible into Beams for Ships of the Line and Paddle Beams for large Steam Vessels stating how far these may fall short or otherwise of what is required for the several ships building or ordered to be built.[86]

Work on the *Thunderbolt* meanwhile was proceeding. Men were ordered to be selected 'from the Ordinary[87] and the Dock Yard to take [her] to Glasgow' on 7 February for the purpose of having her engines fitted,[88] under the command 'of either the Master of the Ordinary Guardship[89] or the Assistant Master Attendant . . . whichever you prefer'.[90] The ship duly sailed to the Clyde, returning to Portsmouth in the summer of 1842.[91] Throughout this period, design work on steam warships continued pragmatically and, as problems arose, instructions on matters of principle and practice to be adopted by the Dockyard were transmitted from London. For instance on 11 February 1842 Barrow wrote urging that there be taken

> . . . special care that the whole of the woodwork of the Coal Boxes of Her Majesty's Steam Vessels whether the side of the Vessel or otherwise, be securely lined with Copper to the very tops of the Boxes so as to guard against the effect of Fire in case of Spontaneous Ignition of Coals – notwithstanding the precautions to be adopted by their Lordships Circular of the 4th Instant . . .[92]

Indication of development on the engineering side comes later this year in a letter from the Admiralty to the Dockyard on 27 October 1842, instructing that the *Thunderbolt's* boilers were to be fitted at Portsmouth 'by the workmen of the Yard' and 'in accordance with the Instructions which form part of the specifications for new Engines herewith enclosed'.[93] Steady progress also continued with shipbuilding, and by the end of 1842 Portsmouth had launched its largest steam vessel so far, the paddle frigate *Firebrand*, 1,190 tons.[94]

Having thus delivered one of a class of paddle warship which turned out to be at the same time the apogee of her type and one of the last of her line, it is appropriate that at about this time comes a reference to the latest evolutionary trend in the technique of ship propulsion. On 28 October 1842, Barrow informed the Admiral Superintendent

Submerged Screw propellers available in 1850
The Science Museum

Captain Sir Thomas Hastings[95] being of the opinion that the trial of different kinds of propellors in the 'Bee'[96] would be as well made at Portsmouth as in the Thames a mile being measured for that purpose from the Platform towards South-Sea Castle and Mr. Lloyd considering that the work could be done as well at Portsmouth Yard as at Woolwich – their Lordships have ordered the 'Bee' to be sent to Portsmouth.[97]

However, it was to be nearly four years before Portsmouth's first screw warship, the *Rifleman*, gun vessel of 486 tons, was launched.[98] In the meantime, the flow of instructions from London, already referred to, continued to arrive in the Dockyard. One such which may have been the fruit of bitter experience, was passed on to Bouverie by Barrow, relative to the fitting out of wooden steam warships

> . . . I am commanded by my Lords to acquaint you that the passages *between* boilers are never to be clothed but the passages *round* [Barrow's emphasis] the Boilers are to be and that there will be sufficient room for every purpose on the passages on board the "Thunderbolt".[99]

The developments foreshadowed seven years before by *The Hampshire Telegraph* were now, in early 1843, mentioned again by that newspaper

> The Honourable Capt. Corry[100] and Capt. Brandreth, Civil Engineer to the Admiralty visited the Dock-yard on Thursday to make their report respecting the enlargement of the Yard, by taking in the Buildings to make a Basin for large War Steamers instead as heretofore of sending them up to Woolwich. The space contemplated to be taken in, is from the lower or north-end of Marlborough-row to the Horse and Jockey public house, at the end of Sandwich Street. Three drawings, with estimates, have been forwarded to the Admiralty.[101]

Whilst the Dockyard was looking ahead to the new extensions, the Admiralty appeared to be dropping its hitherto parsimonious attitude. The Admiral Superintendent had written to Barrow to propose lighting the roads leading 'to the officers' Residences with gas instead of oil'. Barrow responded on 27 February 1843 requesting a scheme to be put forward 'for lighting the Yard *generally* [his emphasis] bearing in mind the proposed alterations in consequence of the New Steam Basin, New Slips etc'.[102] Further evidence of the quickening pace of change in the Dockyard came on 10 March, when Barrow wrote to Hyde Parker, now Admiral Superintendent,[103] covering an

> approved plan for the proposed new Steam Basin at Portsmouth which my Lords have decided to adopt and I am to desire the officers immediately to prepare detailed drawings and specifications in order that the work may be submitted to competition . . . and that arrangements may be made for removing the Boat Houses etc. as directed by their Lordships orders of this date. My Lords further directed me to acquaint you for the Officers' information that the depth of Water in the Basin at *Neap Tides* [Barrow's emphasis] is to be 21 feet.[104]

On the same day, Barrow sent another instruction regarding internal Yard details concerning temporary storage space for boats and masts.[105] On 31 March 1843 a further letter from the Admiralty to the Admiral Superintendent specified the cost of General Repairs to Works and Buildings for the coming financial year as totalling £71,928. In the estimate, item 12, 'The New Steam Basin', came to £30,000. Apart from this, the breakdown was:

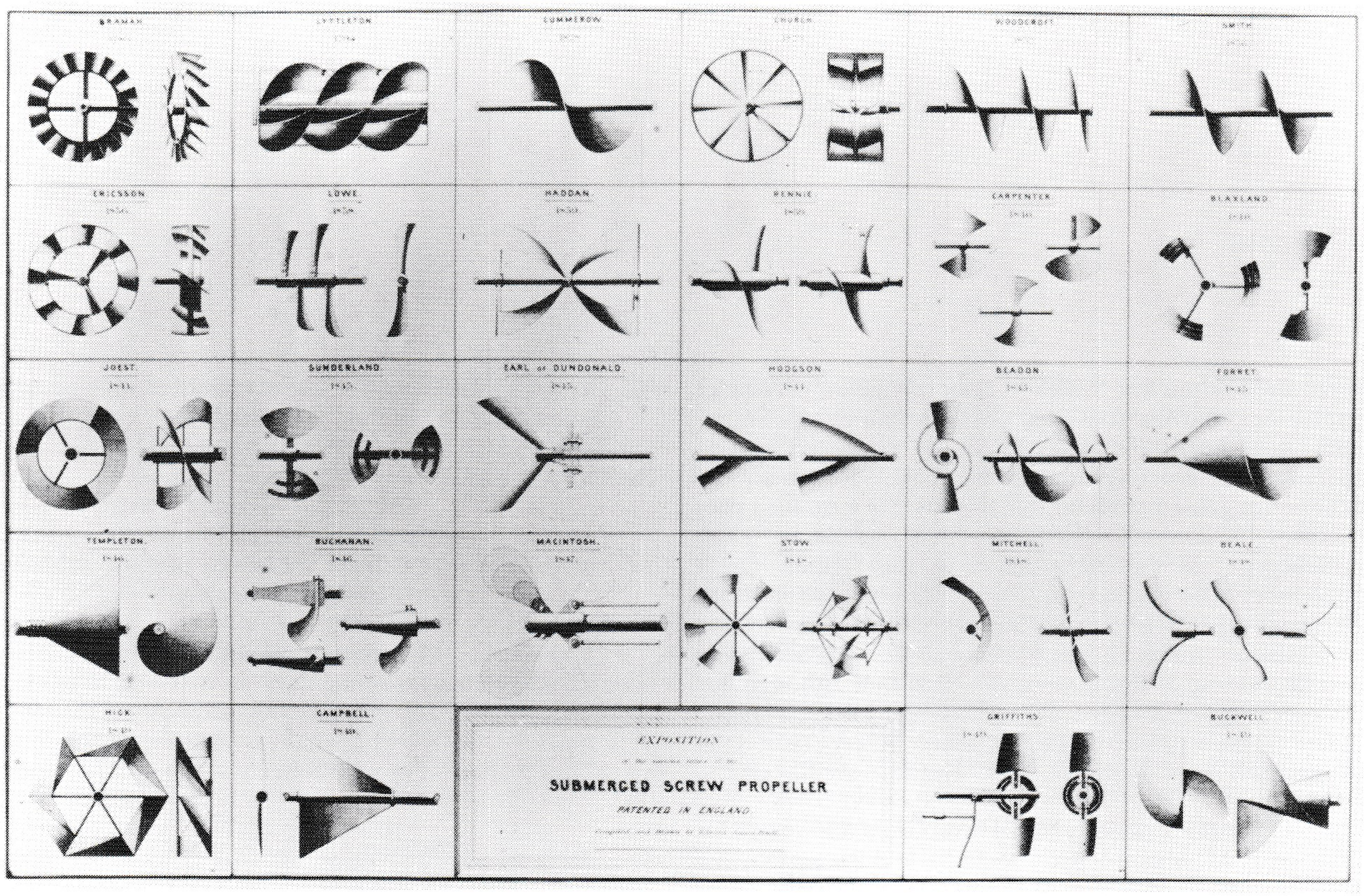
New Machinery	£6,997
New Works and Buildings	£64,931
TOTAL	£71,928

An accompanying letter from the Surveyor[106] requested the Admiral Superintendent 'to cause the enclosed Programme of Work for 1843/44 as approved by their Lordships on the 30th. inst. to be conformed to . . .'.[107] Also in the Spring of 1843, the Surveyor introduced a system of checking the numbers of shipwrights employed on steam vessels; they were in future to be shown separately on a new form prepared for the purpose.[108]

In spite of the apparent new energy displayed by the Admiralty in adapting Portsmouth Dockyard to the Steam Age, *The Hampshire Telegraph* was not impressed. In an article in its issue of 25 September 1843, it complained that not enough was being done

> . . . It strikes us that large as the intended basin is, it will be trivial compared to the requirement of the Navy; that, the Government, therefore, had better, at once, enclose a space six or eight times larger, out of the harbour itself, and for other purposes.[109]

As a 'hint in the hope of doing great good', it advocated 'the purchase of the sea face of that part of Portsea, called the Buildings . . .'. The newspaper concluded by stating that



> An order was issued on Tuesday that . . . all the artisans, excepting Rope-makers, in the dock-yard are to work an extra hour each day, for a month, for the purpose of hastening the progress of the various work.[110]

Amidst the bustle now going on in the Dockyard, innovation in ship-design was not being overlooked, and on 6 November 1843 Barrow addressed the Admiral Superintendent to inform him that 'A new propellor called Ericson's [*sic*][111] is to be tried in the Bee.' This was some seven years after Ericsson[112] had taken out his patent, which again underlines Admiralty caution over the introduction of new technology. This is perhaps the more surprising, in this particular case, because of the military advantages of the screw over the paddle in warships, since it would have permitted the restoration of a full broadside armament. Progress was slow towards the introduction of the screw propeller, and not until 12 August 1844 did an Admiralty Minute direct the Surveyor to prepare two draughts of new vessels, later to be classed as 'frigates', 'one as a paddle wheel and the other as screw'. These ships were to be launched in due course as, respectively, *Odin*, built at Deptford, and *Dauntless*, to be constructed at Portsmouth. It should also be borne in mind that there was on offer, a bewildering selection of 'propellers' produced by various inventors[113] with competing claims, and the Admiralty had to tread warily.

We have noted at Portsmouth the slow build-up of a shore-based engineering organisation to service and maintain the machinery of steam warships. It had so far progressed by trial and error, and had been implanted, or inserted, into the existing Dockyard establishment of Principal Officers,[114] but when engineering problems arose, someone responsible had to deal with them. There was no one at this time of 'Principal Officer' status at Portsmouth qualified to handle technical matters affecting ships' engines. That the Admiralty was beginning to appreciate this by 1844 is shown in a letter to the Admiral Superintendent

> . . . whenever one of Her Majesty's Steam Vessels arrives in port for the repair of her Machinery, you are to direct the Officers[115] appointed to survey it to report distinctly the apparent *cause* of any damage it may have sustained and if it shall appear that it is to be attributed to the neglect or ignorance of either the Engineers or others, you are to cause a very strict enquiry to be made into all the circumstances of the case reporting the same . . .[116]

A need clearly existed for the appointment of a 'Dockyard Engineer' to carry out such surveys on ship-propulsion machinery. Pressure from the local newspaper was also being kept up about the new 'Steam Basin'. On 31 August 1844 *The Hampshire Telegraph* reported 'The Admiralty have determined on the immediate occupation of a large part of the Town of Portsea, called the New Buildings'.[117]

Shaking off the lethargy of earlier years, the Admiralty now wished to expedite work on the paddle frigate *Centaur*, then under construction. On 4 September 1844, Barrow called for a proposal by the Shipwright Officers of 'a sum for Building and completing the "Centaur" by Task with the exception of the Work connected with the fitting of the Engines and Armament'. This ship was later en-

Fleet Review in Spithead 1845
Portsmouth City Musuem

gined by Boulton and Watt[118] but in the meantime, on 23 September, Barrow conveyed to the Admiral Superintendent 'their Lordships' approval of the estimated sum of £6,710' for completing her hull 'by Task'. Presumably the experience gained at about this time by the *Centaur's* predecessor, *Firebrand*, referred to above, would be taken into account in the construction of the former. On 9 September 1844 Captain Sir Thomas Hastings wrote from *Excellent* to the Admiral Superintendent, 'requesting transmission to their Lordships' about '. . . the traversing and depressing of the Firebrand's guns that although her decks Spring less forward and aft than many other of H.M. Steam Ships, still inconvenience would be experienced in working her head and stern guns.' Hastings continued

> I have on previous occasions reported that the decks of H.M. Steam Ships should be laid flat so that the bottom of the slides of the heavy guns should move over them in traversing with the least possible friction.

The report concluded with the remark that

> the bows and sterns do not at present . . . afford all the facilities for fighting head and stern guns which is [*sic*] desirable and which might possibly be obtained by revised construction . . . in the largest classes of Steam Ships.[119]

Further directions as to the strengthening of the frames of steam wooden warships came to the Admiral Superintendent in the form of a letter from the Surveyor of 24 September 1844, informing him

> it is considered necessary that in future the double beams under the pivot guns of Steam Vessels should be bolted together after they are in the Ship for the further support of the Heavy Guns now introduced forward and aft.[120]

As to the *Firebrand*, because of the positioning of 'the long gun, wheels etc. . . . one of the ordinary pillars for Standard Compasses cannot be placed in that Vessel . . .'. A 'Copper head for receiving the Standard compasses together with Skylight and Lamp will be forwarded to Portsmouth for that Vessel'.[121] In the work continuing on the *Centaur*, a shortage of suitable timber for the paddle beams had been encountered at Portsmouth. Presumably the Dockyard had appealed for help to the Admiralty, as the Storekeeper General wrote on 10 October 1844

> the African Timber required for the Paddle Beams and Engine Beams of the Centaur cannot be supplied from any of the other Yards.

The Officers were told

> to report whether timber of suitable dimensions cannot be procured from the cargo of the Cambrian referred to in my letter of yesterday.[122]

As part of the evidence of the growth of the engineering trade in the Dockyard, mention is made of Engineer apprentices there, and the fact was established that they were not to be regarded as inferior to those of the Shipwright trade in terms of pay. Barrow wrote on 17 October 1844

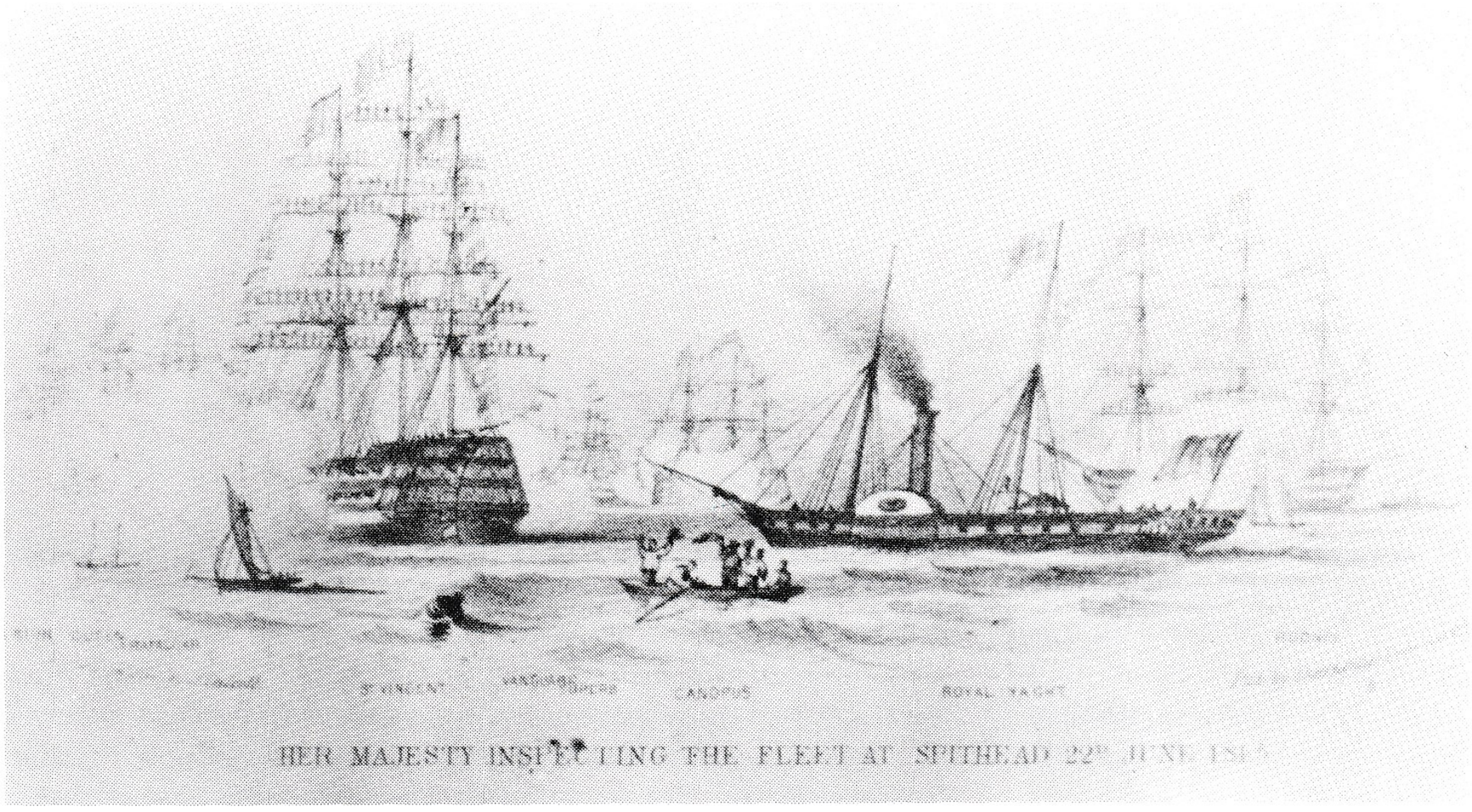
> In reply to the application of Mr. Taplin in respect to the Pay of Apprentices to Millwrights and Engineers their Lordships desire me to state that it should be the same as that of Apprentices to Shipwrights.[123]

As will be seen from the above quotation, this was a period in the Dockyard when new trades were beginning to emerge and work alongside the old-established crafts, some shortly to die out. Engineers, and Sawyers, the latter exponents of an ancient skill involved in the building of wooden ships, were engaged together in the construction of steam wooden warships. Also on 17 October Barrow wrote conveying their Lordships' approval of

> The Sawyers employed by Task on the Centaur and Scourge being continued to be so employed when these ships are finished on . . . Dauntless . . .[124]

which ship, as we have seen, was to be the first 'screw frigate' to be built in the Dockyard.

We have now reached a stage which constitutes a watershed in this era of naval history, and so in the evolution of Portsmouth Dockyard. It introduces the next innovative factor to ship-builder and seaman, namely a vessel with an under-water aperture in the stern. 'In 1845 circumstances required a large increase in the Strength of the Steam-Navy' wrote a naval historian of the period.[125] 'After long deliberation it was determined that the required increase should be made in ships so [i.e., screw-] propelled'.[126] The circumstances involved in this change have been dealt with fully in a thesis[127] insofar as they affected the Royal Navy in general. As far as Portsmouth in particular was concerned, the Dockyard now had to look forward to an increasing rate of development which began to poise it on the verge of a world almost as we now know it. The com-



HER MAJESTY INSPECTING THE FLEET AT SPITHEAD 22ND JUNE 1845

ing of the railway, the electric telegraph, new shore-based engineering facilities, and the introduction of the screw propeller were all to alter the state of affairs and way of life of the early Victorian Dockyard.

The First Screw-propelled Ships

Of the four innovations facing the Dockyard in 1845, mentioned above, the two last-named, the building of the 'Steam Factory', associated works, and the screw propeller, were those which closely affected it; the others were marginal. *The Hampshire Telegraph*[128] early in the year carried a report on 'New Works Improvements etc in Portsmouth Dock Yard', named Mr. Peter Rolt[129] as 'the eminent contractor', and stated that he 'intends to lay the first stone on Monday the 13th. inst.'. We are told 'Thousands of tons of large granite block have been received from Penryn, in Cornwall, which have been worked for coping stones and facings for basin walls.' We may also read in this account that 'The new mast-house . . . [is] 150 feet in length by 80 in breadth, two stories high; the upper floor supported by 24 cast-iron pillars; the lower part . . . fitted with tramroads . . . The flooring is composed of "Claridges Seyssel Asphalte" .'

Turning to the other development of the period, on 25 May 1845, the Hon. H. T. Lowry Corry, First Secretary of the Admiralty, wrote under their Lordships' direction

> to cause a 1st class Steam Gun Vessel to be propelled by a Screw (to be named the 'Rifleman') to be built at Portsmouth on lines which you will receive from the Surveyor of the Navy and to be completed as early in the financial year, as the necessary works of the Yard will admit.[130]

This was followed a day later by another instruction ordering

> . . . Mr. Fincham[131] to furnish the Comptroller of Steam Machinery (without delay) with 16 copies of the usual drawings for inviting tenders for the Engines of the 'Rifleman', shewing the dimensions of the Engine Room, the aperture for the Screw Propellor and every other point requisite for this purpose and he is to state the Maximum weight of the Engines, Boilers, (with water in them) Screw Propellor, and every other article connected with the Machinery, as well as the weight of coles [*sic*] to be carried.[132]

On 7 June 1845, the Admiralty approved the Admiral Superintendent's 'Scheme of Works submitted by him for this month, and the Rifleman is to be proceeded with as soon as other works will admit'.[133] The other vessel within the scope of this paper under construction at this time was the paddle frigate *Centaur*, already referred to. In June 1845, the Admiralty approved the use of 'Task Work' rates of pay on different aspects of these two ships. On the 12th. of that month[134] the Dockyard Officers received authority for 'about 12 Engine fitters' (the first time this trade had been mentioned in the correspondence) to 'be employed three hours extra a day; and also that 50 Smiths may be employed by Task and three hours extra a day for two months to complete the Centaur.' On 16 June approval was given for 'the *Rifleman* being built by task for the sums stated below, except such work connected with her Engines and armament, as cannot be completed until her Engines etc. are in their place

	£
Shipwright labour	1,962
Caulkers	170
Joiners	310[135]

The continuing civil works on the extensions to the Dockyard were accompanied by customary demands for financial compensation from the inhabitants evicted.[136] The grounds for these were loss of accommodation, livelihood, or trade following the enlargement of the Dockyard for the Steam Basin. The Admiralty was in the meantime re-considering the organisation of the work on the extension, and were looking ahead, with reference to arranging

> . . . that it should proceed under the Superintendence of Captain Dennison [Royal Engineers], so that the public may have the full benefit of the ex-

> perience he has acquired in progress of the Factory at Woolwich and as by this means the peculiar acquirments of each officer will have better scope for their excercise than at present, you are to acquaint Captain Beatson [R.E.] that it is their [Lordships'] desire that he should remove to that yard on the 31st. inst. . . .[137]

To soften any disappointment Beatson might have felt over this transfer, he was directed 'to transmit a statement of any pecuniary loss he may incur by this exchange'. In connection with the civil engineering works going on in the Dockyard, the dispossession of some of the residents of Portsea has been mentioned. *The Hampshire Telegraph* made reference to this in its issue of 12 July 1845.[138] In an item headed 'New Steam Basin', it reported on the progress of construction, and 'The business of removing about 130 occupants from their various localities'. The newspaper stated that this 'has been most ably managed by Mr. James Newton Robinson and Mr. Edward Wells, the Admiralty Surveyors and Valuers; and Government has testified much consideration and liberality in the progress of these ejections'. The cases in which agreement could not be reached out of court, were decided by Jury. The newspaper was of the opinion 'that if the vendors had left it to the crown they would have had more money'.[139] and concluded 'The entire purchase money we believe is not quite 60,000l.'[140]

Turning now from the civil engineering works in the Dockyard we have to consider another development in naval thought of the time, namely the entry on the scene of the 'Steam Battleship', also sometimes referred to as the 'Screw Liner' as in Line-of-Battleship. These were conventional 'three-decker' sailing warships of approximately 100 guns, not very different from the *Victory*, into which steam engines driving screw propellers were inserted. The function of these ships was to meet a particular need, that of acting as mobile forts, and for this reason, another name given to them was 'Blockships', since their purpose was coastal defence[141] 'to fortify . . . sensitive zones and protect them against any *coup de main* more cheaply than could be done by large scale fortifications'.[142] Though this development[143] did not directly affect Portsmouth Dockyard[144] to any great extent in the mid-1840s, it foreshadowed conversion work on existing sailing ships, as opposed to new building, undertaken a decade later on vessels intended for a sea-going role.

While this evolution in the theory of naval tactics was taking place, work was continuing on the construction of purpose-built steam wooden warships at Portsmouth, in particular the paddle driven steam sloop *Scourge*, 1,128 tons. At the end of July 1845, the Admiralty had enquired when she would be ready for commissioning,[145] her launch having taken place over eight months before,[146] but on 18 August there was a delay to the work on her. Doubts arose about the fitting out of her shell-room,[147] and on 22 August, operations on it were suspended until further orders. We have already noted the pragmatic approach by the constructors of the period. Another procedure which was used might be called that of 'trial and error'. We have seen that *Rifleman* was the first wooden screw-driven warship to be laid down at Portsmouth. At the same time the Admiralty had decided to experiment with the building of an early *iron* sister ship, *Sharpshooter*, to be constructed by a private firm, Ditchburn and Mare of Blackwall,[148] the intention being presumably to 'try' one against the other,[149] the practical lessons learned to be applied for the betterment of the art. In the particular case of *Rifleman*, there is evidence of the feed-back of information from Portsmouth Dockyard to private enterprise. On 19 August 1845 John Edye[150] wrote from the Admiralty requesting the Admiral Superintendent

> to cause the Drawings of the Inboard Works of the Rifleman to be immediately transmitted, also the scantlings[151] of the Wood and Materials not named in . . . the Specification . . . for the information of the Contractors who are building the Sharpshooter in order that the Experiments of the wood and Iron vessel may be tested as to Weights Expense and Efficiency.[152]

The tenders put out earlier for the *Rifleman*'s machinery had been awarded by 31 August 1845, to the firm of Miller and Ravenhill.[153] They were to supply

> . . . a pair of engines . . . to be ready for fixing in 7 or 8 months. [Miller and Ravenhill] have been directed to put themselves in communication with the Master Shipwright with a view to reducing the height of the Boilers and keeping them if possible below the Load Water line[154]

another example of co-operation on a sensible basis between the public and private sectors.

The Admiralty was now anxious to press ahead with the building of screw-propelled ships, having presumably by this time appreciated the advantages of restoring to warships an un-interrupted broadside along which to mount guns. The Secretary wrote on 1 September requesting 'a report on the number of hired Shipwrights and other Artificers'

> which, after providing for the other work of the Yard would be required . . . to complete the

"Rifleman", and to advance the "Arrogant" and "Dauntless",

all screw vessels, to a state of more than half completion by the end of the financial year; the men to work by 'Task'[155]. The list of trades and numbers agreed by the Secretary of the Admiralty was

Shipwrights	120	
Joiners	36	
Smiths	48	
Sawyers	42	
Caulkers	22	
Labourers	100	substituting for that number of Shipwrights

making a total of 368 men. The hundred labourers were to be replacing that number of members of the shipwright trade, as some of the latter were considered to be 'doing work which could be executed by labourers'.[156] So keen were the authorities to find more dockyard labour now, that the Admiral Superintendent was told to have his Officers 'report on how many were obtainable in the neighbourhood of Portsmouth in order to decide what measures may be taken for procuring the remainder elsewhere'.[157] The Dockyard was also instructed, on 10 September 1845, that

> if it should be found necessary . . . to take any portion of the hands off the steam vessels . . . to put them on other work you will report the same accordingly [so] that their Lordships may consider whether . . . to enter additional hands for the advancement of the Steam Vessels.[158]

Compared to the previous restrained attitude, this represents the appearance of an energetic and determined approach by the authorities. Yet there was no direct threat to peace, other than the ever-present worries about a French invasion, which the 'Steam Blockships' referred to earlier, were being introduced partly to counter. Possibly, therefore, this was a symptom of the quickening pace of industrial development throughout the country, of which the 'Railway Mania' was another.[159] The line to Gosport was opened in 1842,[160] and such developments must have contributed to the spread of ideas and expansion of commercial activity.

Also on 10 September 1845 the Admiralty instructed the Admiral Superintendent to furnish 'Engineers Drawings for the Dauntless as soon as they can be completed in order that tenders may be called for her engines', and on 2 October, the Surveyor informed him of the 'Sums allowed for building the following vessels by Task'. The letter instructed that the amounts mentioned below were

> . . . to include the whole of the work to be performed by the Shipwrights, Caulkers, Joiners, Painters and Braziers, but exclusive of . . . the Engines, Guns and . . . the Rigging as also . . . the Paddle Box Boats
>
> | | £ |
> |---|---|
> | Arrogant | 9775 |
> | Dauntless | 7732 |
> | Rifleman | 2535 |
>
> which are to be the total sums paid and to include the several amounts already expended.[161]

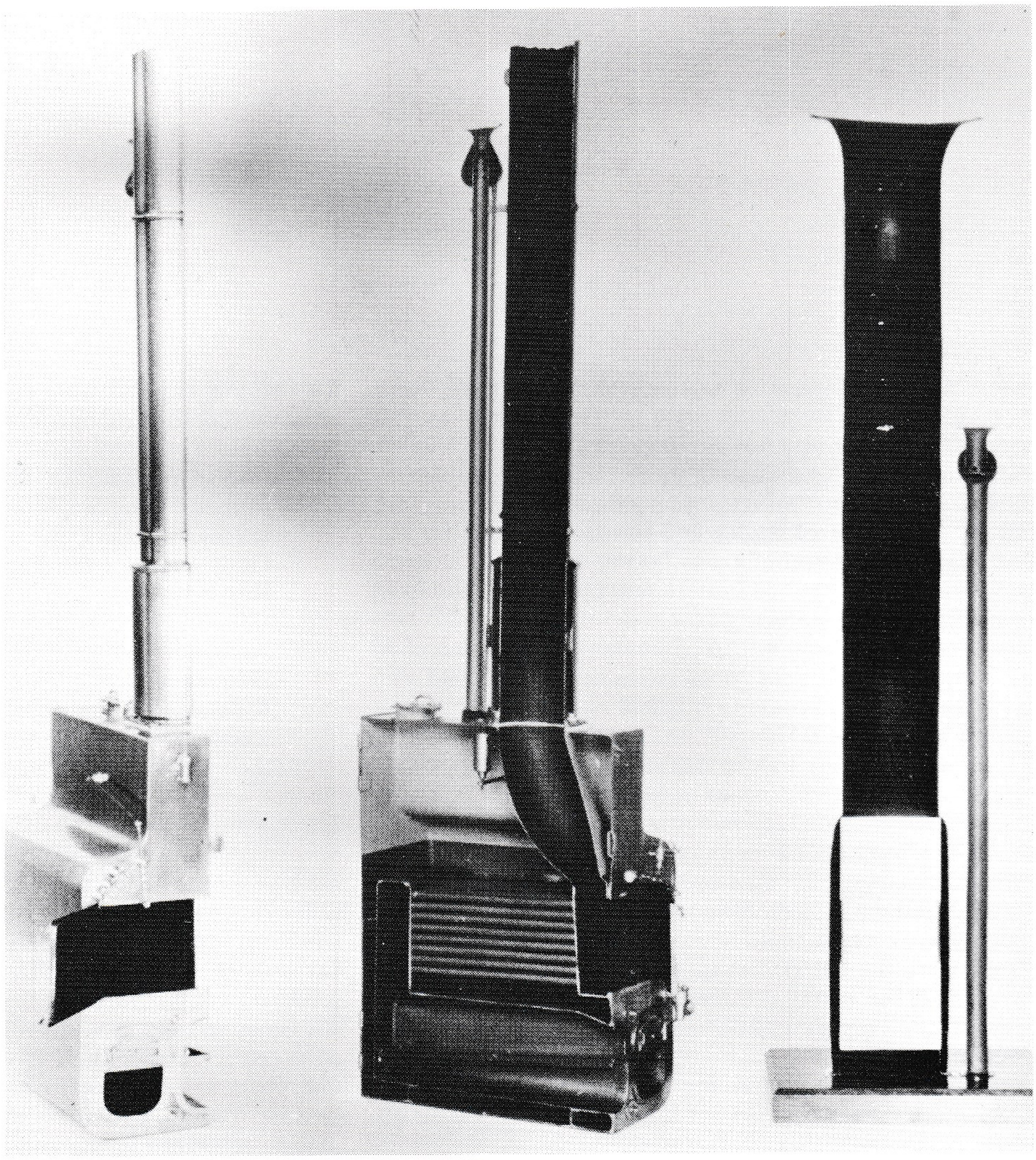
These ships were all to be screw-propelled. Their construction constituted a significant step forward in the development of the mid-nineteenth century Dockyard, albeit work was still in progress on the paddle frigate *Centaur*. Boulton and Watt, her engine builders, told the Admiralty in October 1845 that they would 'fix her engines' (*sic*) on 20 December. The Board expressed 'disappointment' with this late date, and the firm was told 'in future contracts will be enforced'.[162] Portsmouth Dockyard was accordingly told that *Centaur* was 'not to be navigated to the River at present'.[163]

Such set-backs to the completion of ships building did not of course affect the work on the new Steam Factory, and the question of the machinery to be installed there now came under consideration. On 16 October 1845 the Admiralty forwarded a

> copy of a letter from Messrs Lloyd[164] and Murray[165] relative to the capacity of the Steam Establishment at Woolwich and to acquaint you that means adequate to a power of 3,000 horses at least should be provided at Portsmouth and that the buildings of every description should be distributed over the ground as to be capable of future extension.[166]

The continuing problem of ships' hulls resistance to the strains imposed upon them by steam machinery has already been alluded to. That machinery itself was subject to shocks from the vessels' armament. The Admiralty, on 27 October, addressed the Admiral Superintendent on the matter

> . . . Sir Charles Ogle[167] has been directed . . . to lend such number of men as may be necessary for the purpose of sending the Scourge (previous to her being commissioned) out of the harbour as may afford her a range for her Shells clear of any passing



shipping or Boats to try the effect on her machinery of firing from her heavy Mortar . . .[168]

Various specialist officers, military and civil, including '. . . the Engineer [*sic*, although one was not officially appointed until the following year] and Mechanist'[169] were to attend these trials and 'report their opinion . . . as to the efficiency of the Vessel and Machinery for bearing such description of ordnance'.[170] Apart from the structural aspects of the wooden steam warships' hulls, other, if minor, innovative features were under consideration at this time. On 12 November 1845 'My Lords . . . approved of Commander Crispin being allowed to fit his Telegraph for conveying the Word of Command into the Engine Room to the "Scourge" . . .'.[171] This appeared to be a rare chance for a local engineering firm to participate in a new development, but it was not to be. Hamilton responded to a proposal from the Dockyard Officers 'that the Telegraph for the "Scourge" and the "Rattler" should be provided by Messrs Rannie Engineers[172] in the Town of Portsmouth' by passing on their Lordships' orders that this work '. . . must be performed by the Dock Yard and at such times as the Public Service and other Works will admit'. This is further confirmation of the stifling effect the presence of the Dockyard had on private engineering enterprise in the town.[173]

By 21 November 1845 the trials carried out on the *Scourge* by the firing of her heavy mortars had been evaluated. It became necessary to dock the ship 'in consequence of the leaking condition of the Port Sea Cocks . . . to ascertain and report whether this defect has been occasioned by the firing of the Mortar . . .'[174] However, as by five days later instructions were issued to 'cause Her Majesty's Steam Sloop the Scourge to be fitted out . . . for Service at Sea',[175] presumably no fundamental defects had been discovered. Meanwhile, the trend away from the paddle steamer continued, as preparation for the building of screw-driven warships went ahead. On 15 December the Admiralty advised that 'My Lords have accepted Messrs Penn & Sons[176] tender of the 11th Instant for a Pair of Engines for H.M. Ship "Arrogant" . . .'. There followed a summary of the specification, the main points of which were two-fold

1st The Form and Position of the Boilers, the Size and Position of the Engines are to be modified

if necessary to the Satisfaction of their Lordships,–

2nd The Funnels are to be fitted on the sliding principle with one or two joints, as their Lordships may hereafter determine.[177]

The 'sliding' or 'telescopic' funnels were a feature of early steam warships; they could, by the use of this system, be lowered to level with the top edge of the bulwarks, and thus not interfere with the process of making sail.[178] As work on these early screw warships continued, the problem of fitting propellers to ships continued to exercise minds at the Admiralty. On 23 December 1845 '. . . Drawings of the mode of fitting the Screws in the Ajax, Edinburgh[179] and Rifleman' were sent for the guidance of the Dockyard Officers.[180]

The trials of the *Scourge* when firing her heavy armament have already been mentioned. A further experiment was ordered for February 1846. On the nineteenth of that month, Taplin was ordered to proceed again in her 'to the back of the Isle of Wight' so that 'further proof of the effect on the Engines by firing of the Mortar may be made as recommended by Mr. Taplin'.[181] More experience of the joint effects of heavy weaponry in use, and the strains imposed by steam propulsion, was being gathered at this time. On 2 March 1846 the Surveyor informed the Admiral Superintendent

> for the officers guidance that in all cases where the 8 inch gun of 65 cwt. or larger guns are ordered to be mounted on the Spar Deck of Frigates or Steam Vessels, the Beams of such Decks where these guns are placed are to be clamped or strengthened with an Iron Plate provided the Officers consider additional Strength wo[uld][182] be required.[183]

Adaptation of sailing navy practices to the Steam Age were also being dwelt upon, when on 24 March, the Shipwright Officer, John Fincham,[184] had his 'plan for stowing the Hammocks in the "Dauntless" and 'Rifleman" ' acknowledged.[185] Hammocks were customarily stowed in sailing ships in nettings on top of the bulwarks as protection against splinters in action. Fincham was acccordingly told to submit 'a complete plan showing in what manner the Bulwarks of Steam Vessels are lowered, to admit of the guns on the Spar deck[186] being fired'[187].

Whilst these adjustments to the steam warships under construction or already afloat were being dealt with, work was proceeding on the civil engineering of the buildings and installations being specially prepared to service them. In February 1846, the Admiral Superintendent had submitted 'a plan and description of the Buildings proposed to be erected for the Steam Engine Factory at Portsmouth in order to allow of Steam Engines to the amount [*sic*] of 25,000 Horse Power being kept in repair'. Corry's reply the following month was that

> . . . My Lords approve of the . . . general plan to which the Factory is to be extended by [full stop ?] the Director of works is to send in detailed plans of such portions of the general arrangement . . . for their Lordships approval.[188]

The building plan for ships, for the coming financial year, 1846/7, was sent by the Admiralty to the Dockyard on 26 March 1846.[189] About a month after it was promulgated, a further schedule, dated 28 April, arrived at the Dockyard. It contained an estimate of cost for 1846/7 of the

Steam Basin	£100,000
Factory Buildings	£20,000

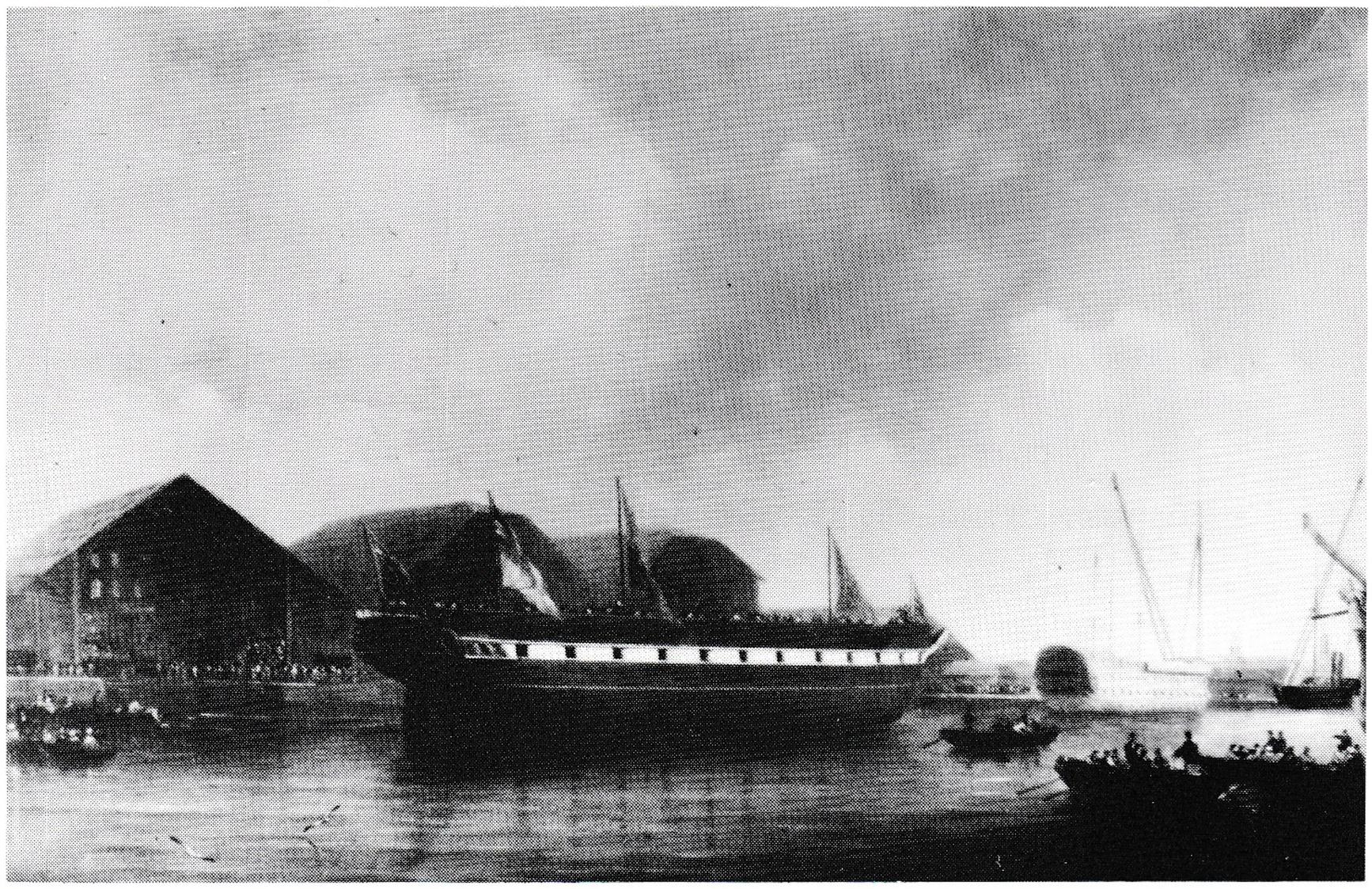
with approval for the work to be carried out.[190]

Reverting to the ship construction programme mentioned in the preceding paragraph, and one of the vessels included in it, *Dauntless*, outside contractors were now being brought in for the delicate and still novel – for Portsmouth – business of fitting screw propellers. The Admiralty wrote on 2 May that

> Mr. Gordon, the [London] Agent of Mr. Napier has been desired to furnish as soon as he possibly can, a drawing shewing the last alteration in fitting the Screw Propellor for the Dauntless.

John Fincham, at Portsmouth, was instructed 'to communicate direct with Mr. Gordon . . . if he thinks the service will be expedited by doing so'.[191] The Admiralty clearly had three important factors in mind: firstly, they drew on the technology of outside organisations which possessed the only experience in this relatively new field; secondly, they spread their risks, by using more than one contractor, and thirdly, they injected a note of urgency into the proceedings, as will be observed in the quotations from the correspondence. Even with hindsight, it is hard to fault their policy at this time.

That more expertise was required of the Dockyard then seems undeniable, as understandably the Royal Navy would not want to put itself *in perpetuum* wholly at the mercy of engineering entrepreneurs. Portsmouth Dockyard needed an expert technical assessor, one of the new breed of the rising profession of Engineer. We have seen that Robert Taplin in 1846, then forty-six years of age, and described so far as 'engineer', 'Mechanist' or 'Millwright',



was locally-bred and had emerged from obscurity in the latter trade. He had distinguished himself sufficiently in the Dockyard scene to be consulted on engineering matters arising therein, although he did not have the status of a 'Principal Officer'. Andrew Murray, later to become Chief Engineer of the Dockyard, did achieve that status,[192] and was thirteen years younger than Taplin. Having been apprenticed to one of the great engineering figures of the day, Fairbairn, and later his partner, Murray's experience, professionally and geographically[193] was wider than Taplin's. Murray was appointed '*Acting*[194] Chief Engineer and Inspector of Machinery at Portsmouth . . . by Warrant dated the 9th.' [May 1846].[195] His instructions were sent to the Dockyard on 20 June.[196] One of his first preoccupations would have been that referred to in its communication 18 June 1846, when the Admiralty acknowledged a suggestion from Portsmouth that 'a competent person be appointed to superintend the fitting of screw propellers'.[197] This would mean less dependence on private contractors, and infers that the Dockyard felt that it was absorbing the new technology. However, the planning of new techniques still seemed to devolve upon the Master Shipwright, John Fincham. In this post, as head of the premier Dockyard trade, he would be deferred to on many points outside his own strict field. Thus, on 30 September 1846 'relative to the apertures for the admission of Air to the Engine Room of the Dauntless and Termagant'[198] the Admiral Superintendent was told to 'call on Mr. Fincham to propose a plan for causing a circulation of Air fore and Aft as suggested by him.'[199] This problem was given attention again a few days later, when the 'drawings of the general fittings and ventilation of the Cyclops' were sent 'for the officers guidance in fitting other steam vessels . . .'.[200] i.e. screw or paddle-driven. But as has been suggested, the heyday of the paddle warship was already passing, and the main business of the shipbuilders in the Dockyard was now with screw-propelled ships, insofar as steamers were concerned.

Reference to Admiralty administrative procedures to cope with the intricacies of steam technology has already been made. A circular now arrived from London, adverting to 'Much inconvenience having [arisen][201] from the incompleteness of the Returns from the different Dockyards . . .'. To help overcome this, the Admiral Superintendent was ordered to state

> . . . in all cases where a Steam Vessel is concerned whether the progress in fitting and repairing the Machinery corresponds with that of the other works; and whether there is any other cause such as fitting the guns etc. that would . . . prevent the Vessels from being fit for immediate service when required.[202]

We have seen how heavily the Admiralty relied on the Master Shipwright for advice on matters not wholly within the confines of his trade. Although Andrew Murray had been appointed Acting Chief Engineer five months earlier, in November 1846 the authorities in London were still referring what would seem to be primarily engineering subjects to John Fincham. For instance, the Admiral Superintendent was told[203]

> . . . My Lords desire you will inform Mr. Fincham that Messrs Miller and Ravenhill have been acquainted that the Machinery for raising the Screw Propellor of the Rifleman is to be fitted according to a plan to be communicated to them by Mr. Smith.[204]

The Admiralty was now enquiring about the possibility of laying down the *Shannon*, a large screw frigate, but, as the work on the *Dauntless* was still proceeding, in order to clear the slips, preference was given to completing two sailing ships.[205] *Dauntless* was launched on 5 January 1847 and fitted for her 'voyage to the Clyde to receive her Engines'.[206] An account of her launch appeared in *The Hampshire Telegraph* four days later, from which we may learn that 'Excellent arrangements were made under the direction of Mr. Fincham to accommodate the public . . . [in] very bad weather . . .'. After the ceremony of naming

The Launch of DAUNTLESS, *5 January 1847*
Artist unknown
Portsmouth City Museum

was performed, the account continued ' . . . the bottle passed to a select few who drank success to the *Dauntless* . . .',[207] whereupon she took to the water.

With the launch of this first major screw warship from Portsmouth, this part of the paper may be drawn to a conclusion. Work on the Dockyard extension continued, and it was not until May 1847 that the 'New Basin for War Steamers' was to be officially opened. There remains the impression, at the end of the financial year 1846/7, that the new Acting Chief Engineer was not having much of a say; and we obtain hints later that there was friction in the relationship between shipwrights and engineers. However, it is possible to close this section on a technologically positive, forward-looking note by quoting from an Admiralty letter of 17 March 1847

> My Lords have informed the Electric Telegraph Company that they are desirous that the extension of the Line into Portsmouth Yard should be completed without delay.[208]

and three days later the Admiral Superintendent was told

> I am to acquaint you that the Electric Telegraph Co. has been directed to complete the line of Telegraph at once into Portsmouth Dockyard.[209]

The Steam Basin and the Early Work of the Dockyard Engineering Department, 1847–52

In 1847, the high summer of the Victorian era, epitomised by one writer on the technological history of the period by the Great Exhibition of 1851,[210] was only four years distant, and a future of peace and prosperity was looked forward to by many. Nevertheless, at Portsmouth Dockyard, preparations to handle 'war steamers' continued. The Secretary of the Admiralty informed the Admiral Superintendent on 22 March 1847

> My Lords having accepted Messrs Fairbairn's[211] tender for the construction of two caissons[212] they have been directed to send a proper Person . . . to receive instructions from the officer in charge of works.[213]

Perhaps this was an early example of Murray's influence being wielded by steering a contract the way of his former Master and partner. At this time, on 23 March, there is the first evidence of Murray's being dovetailed into the Dockyard organisation. Hamilton wrote to convey their Lordships' desire to the Admiral Superintendent

> that you call on Mr. Murray to communicate with Mr. Fincham the builder of the Dauntless on the subject of her Machinery so that a mutual co-operation and understanding be established between the two Departments and a greater completeness and efficiency thereby obtained: and Mr. Murray is also to report to the Comptroller of Steam Machinery[214] [at the Admiralty] the state of forwardness of the work and the probable time of its completion . . . and you are to call the attention of Mr. Murray to the necessity of having the Dauntless ready . . . with the utmost despatch.[215]

Andrew Murray's involvement in the work of the Dockyard was further strengthened when on 12 April 1847 the Admiralty told the Admiral Superintendent to

> order the Chief Engineer of the Dockyard to make a fortnightly inspection of the Machinery of every Steam Vessel whether in commission or not, at Portsmouth, and you are [to][216] transmit periodically a report of the state and condition thereof . . .[217]

Rather belatedly in the new financial year, not in fact until 28 April 1847, did the Surveyor send to the Dockyard the Programme of Works for the coming twelve months. Fourteen ships were listed, of which six were sailing vessels. Of the eight remaining, three, *Vigilant, Sepoy,* and *Cossack* were 'suspended', and, in time, cancelled. A total of 935 men were recorded as to be employed, 294 on the ships building, and the rest on 'other works in the Dock Yard'.

Although, as has been seen, the new Dockyard Chief Engineer was being integrated into its organisational structure, it was to Fincham that 'Mr. Smith'[218] who had 'been desired to proceed to Portsmouth to submit plans for fitting shipping and unshipping the Screw Propellor for H.M.S. Dauntless', was to report, early in May 1847.[219] The fitting of this new means of propulsion was undoubtedly occupying much of the Dockyard's time during this period. On 19 May 1847, the Admiralty, having considered proposals from Fincham 'relative to the form of apertures in the Arrogant and Rifleman' ordered that the latter 'and Sharpshooter . . .[220] be sent to Portsmouth as soon as they have been tried on the River . . .'

> the Rifleman is to be altered without loss of time according to the plan proposed by the Master Shipwright, but . . . no alteration is to be made in the Arrogant until the Rifleman has been tried after the alteration has been made.[221]

In spite of preoccupations over screw propellers, other innovative developments were not overlooked. At the

Baltic Fleet leaving Spithead, 1854
The Science Museum

same time as the above instructions were sent, orders went to ' . . . Mr. Fincham that the Funnel of Dauntless is to be made with one joint',

> so that the Funnel when lowered may interfere in the least degree with arrangements of the deck and the working of the sails.[222]

Steam was clearly still regarded as an auxiliary means of propulsion, but gradually the Admiralty was beginning to take the Dockyard engineering department into its deliberations when an obviously technical problem arose. '. . . the Master Shipwright and Chief Engineer' on 4 June 1847 were ordered

> to make a special report as to the best means in their opinion to prevent the recurrence of similar fractures in the Entablatures[223] of the Scourge[224] bearing in mind the expediency of allowing the Entablatures to have some play vertically and probably of strengthening the Deck.[225]

That a ship launched only three years earlier was already showing signs of structural strain, would have been worrying for the Dockyard. Maudslay's were told to send 'a competent person forthwith to assist' with the examination of further problems discovered in the *Scourge*.[226] Taplin and Murray were both called in, consulted about her defects, and directed to dock her to have them remedied.[227]

Despite the troubles with the *Scourge*, yet another paddle warship, the frigate *Furious*, was ordered to be built at Portsmouth,[228] but she was to be the last of her kind[229] launched from the Dockyard. In the meantime, a minor screw-propelled war vessel, the *Plumper*, classified as a sloop, was put in hand 'the sum of £3196 being appropriated for building [her] . . . by Job . . . , also of . . . £150 for works incidental to fitting Engines, Rigging etc'.[230] Further evidence of the Admiralty's desire to increase Dockyard engineering facilities came on 29 September 1847 in a letter stating that as 'it appearing to My Lords that the number of Boiler makers . . . is inadequate to keep pace with the demands of the Service', Murray was to report '. . . whether a larger number than six Boilermakers for which he had applied could not be employed'.[231] As activities thus intensified, the main effort was being directed towards screw-driven ships. On 7 October the Admiralty wrote that '. . . Messrs Miller and Ravenhill have been desired to prepare and deliver . . . a new Screw Propellor for the Rifleman'.[232] The policy of evaluation was again followed. 'Before . . . the new Screw is fitted . . . a careful trial is to be made of the speed of the vessel with her present Screw in order to ascertain the precise value of the alterations . . . made to the afterbody of the Vessel'.[233] Running parallel with the evolution in ship design and propulsion, had been the continuing work on the extension to the Dockyard and the construction of the Steam Basin. A major event for the town and its economy[234] was the 'Opening of the New Basin in This Dock Yard for War Steamers, by Her Most Gracious Majesty in Person,'[235] which took place on 25 May 1848. Even so, just over four months later, 4 October 1848, the Admiralty decided that '. . . a general revision of the Dock yards may lead to very useful results', an ominous phrase, which has a familiar ring. It was contained in the preamble to a 400-word circular[236] which set out the terms of reference for a 'Committee consisting of Captain Milne,[237] the Surveyor of the Navy[238] and Mr. Ward . . .'. As far as concerns, indirectly however, the subject matter of this paper, the main point the committee had to enquire into was '. . . manual labour saved by the application of Machinery . . .'.

Following reference earlier to the problems caused by the use of salt water in copper boilers, and to the planned increase in boiler-making capacity, in December 1848 '. . . my Lords having taken into their consideration the expedience of using . . . Boilers constructed of Muntz's metal or copper, or partly of both . . .', Murray was ordered to prepare '. . . an estimate of a set of Boilers made of these Metals . . . for vessels of the Driver's class of 280 Horse Power'.[239] He was also to state 'the rate per ton at which they can be made in the [Steam] Factory',[240] which is evidence that the Admiralty was acting on experience gained in service, and was willing to innovate to overcome technical problems presumably encountered at sea. A feature of seagoing procedures for the early screw warships at the time was the now much-quoted order: 'Up Funnel, Down Screw', given when a ship took in her sails and got up steam. So, on 9 January 1849, Murray was reminded of 'their Lordships' orders of the 12th ult[imo]' requiring him to forward plans of '. . . the apparatus as fitted in the "Dauntless" . . . for raising the propellor.'[241] More evidence of a feedback of information and experience gained under service conditions to aid the Dockyard with the introduction of new technology came in an Admiralty Circular of 29 January 1849,[242] wherein it was ordered that

> The coals in one of the Bunkers of the "Stromboli" having ignited spontaneously owing to the presence of oakum[243] chips . . . left in the bunkers

the Dockyard was

> to caution the Engineers . . . of any Steam Vessel that may be fitting . . . against allowing any oakum

chips . . . being thrown into the Coal Bunkers.[244]

As a result,

> In future when Steam Vessels are fitted or repaired Test Tubes for ascertaining the temperature of the Coals are to be fitted and carried down to within two feet of the bottom of the Coal Boxes.[245]

Other dangers were implicit if early steam ships were not operated with a sufficient degree of care. Shortly after the date of the above instruction, news of an alarming incident filtered back to the Admiralty, and a withering reprimand was on its way to the Dockyard. The Admiral Superintendent was told that as

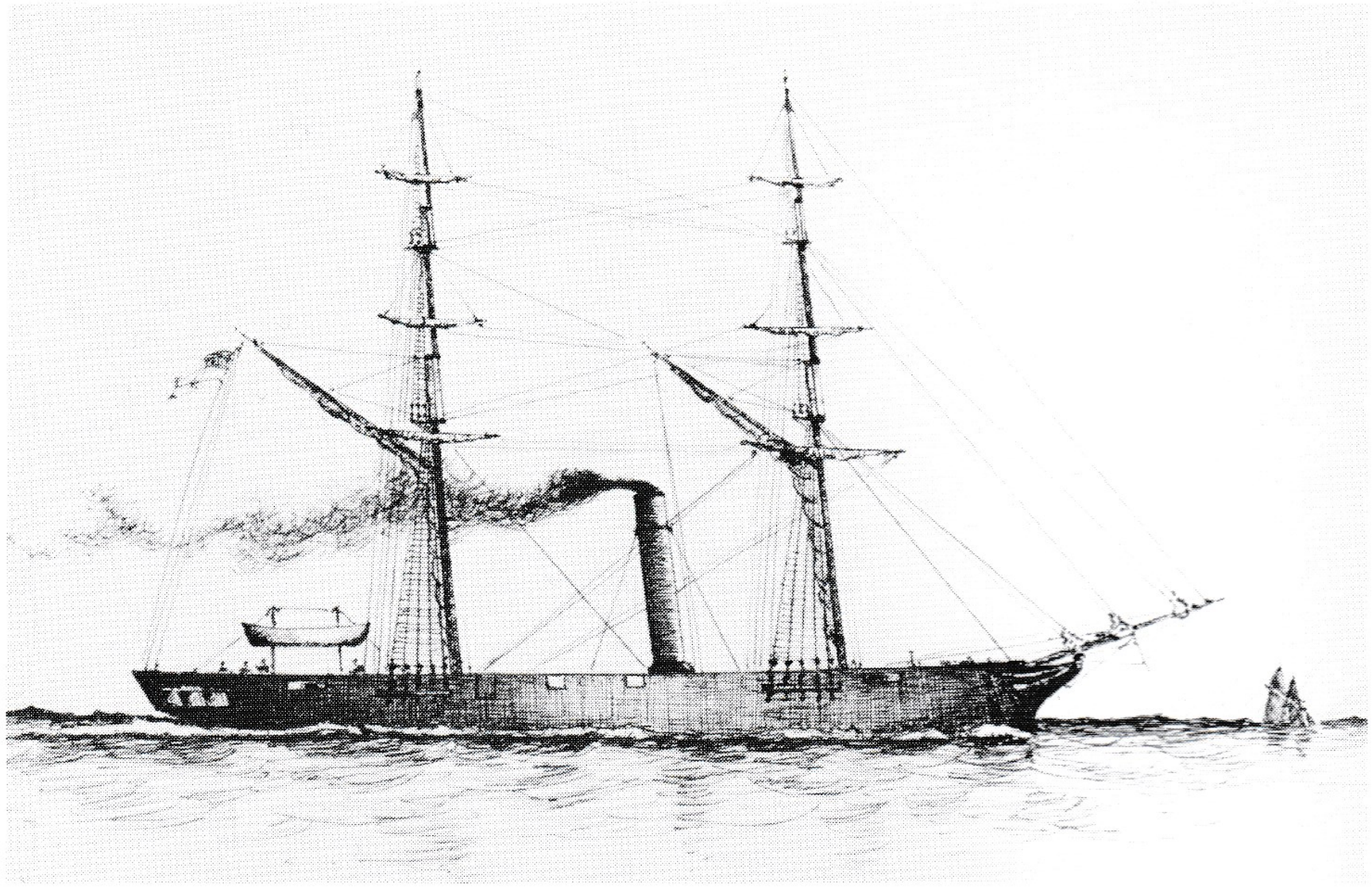
> . . . in going from Woolwich to Portsmouth the funnel of the "Arrogant" was *red hot*, and therefore in a dangerous state . . . you will take *immediate* steps to ascertain whether such was the case, and if so . . . to call upon the Officer and Engineer, in charge of the "Arrogant" to explain why this has not been officially reported . . .[246]

As a result the Master and the Engineer were admonished by the Admiralty through the Admiral Superintendent; and the latter was also censured for not having brought the matter 'to the notice of the Board'[247] himself. Meanwhile *Arrogant*'s slightly smaller 'sister', the screw frigate *Dauntless*, which had been launched on 5 January 1847,[248] was still being worked on by the Dockyard in 1849. On 11 March of that year there was discussion going on as to whether adjustments to her drive shaft should be made. As these would have entailed removing her Shell Room 'and other internal fittings near . . .', the Admiralty decided not to proceed.[249] The ship was not satisfactory as built, and in 1851 she was lengthened.[250]

On 26 August 1850, the paddle frigate *Furious* was launched.[251] This class of ship's usefulness had been overtaken by events, and no more paddle warships were built at Portsmouth within the time-span of this paper. The Admiralty's 'Programme of Works' for 1850–51 reflected a slowing down of steam ship building, listing as it did, only *Shannon* and *Bacchante*, both screw frigates, apart from the *Furious*, already mentioned. Five other ships were included, all laid down as sailing vessels and later 'engined'.[252] Even if the building of ships was proceeding only slowly, there is evidence of work being carried out in the Steam Factory which gave experience to sea-going ships' engineers. On 26 December 1850, their Lordships approved of

> the 300 H.P. Boiler for the Stromboli [being] tubed[253] by the Assistant Engineers in the Factory Workshop with a view to instructing them in that operation . . . required frequently at sea . . . My Lords have no objection to Naval Engineers being so employed . . .[254]

This was an instance of the sensible use of surplus labour, since the engineers would have more time on their hands in harbour, and demonstrates a degree of flexibility in the naval/Dockyard relationship at the time. That there was friction ashore, within the Dockyard organisation, between the old-established shipwright trade, and the rising profession of engineering, is shown by a letter dated 1 July 1851[255] the Admiral Superintendent received from the Admiralty. It referred to an apparent dispute between the



Master Shipwright, John Fincham, and the Chief Engineer,[256] Andrew Murray, involving

> . . . the communications [between them] . . . on the question of the internal fittings connected with the Machinery of the Edinburgh . . . My Lords cannot but remark that throughout . . . there appears a want of cordial cooperation, and unanimity of action between the two departments.

The Admiralty came down on the side of Fincham, observing that

> It was the business of the Chief Engineer (in preference to writing . . .) to have gone to [Fincham's] Office and consulted with him unreservedly . . . .

'The Master Shipwright being the Senior Officer',

> if the Chief Engineer should not of himself seek (which it is his duty to do) for every information connected with his branch of the subject the former Officer should require the attendance of the latter. . . .

This incident serves to epitomise the problem of the early engineers in finding a place for themselves in a long-established hierarchical organisation. It may seem strange to us that the Chief Engineer did not have the final say on 'the internal fittings connected with the Machinery' of a sailing ship being converted to steam propulsion, but the Victorian engineer was still struggling for recognition in the marine field.[257]

Conclusion

This is a convenient point at which to conclude and take stock. We need to relate the Dockyard's work on steam wooden warships to technical developments in the rest of industry in the twenty or so years under review in this paper. An historian has written of the late 1850s '. . . outside the textile factories and mines, iron works and railways, steam power was still a rarity . . . half a century after Watt's patent had lapsed . . . '.[258] During the period 1832–1852 Portsmouth Dockyard built fifteen steam warships as against twelve sailing vessels. It is known that whilst ship-building trades existed locally outside the Dockyard, there were no skills to form the basis of a marine engineering industry, and these had to be imported from the Thames Estuary. Ship-building in the naval Dockyard as such had been carried on at Portsmouth since 1650,[259] so there was no lack of experience in hull construction by the traditional, plank-on-frame, carvel[260] method. Into such a hull, an innovation in the form of a marine engine, with all its attendant stresses and strains whilst in motion, had to be fitted. With minimal experience, Portsmouth's Dockyard tradesmen had to cope in twenty years with a revolution in ship-building, and graft it on to a technique which had hardly altered, as we now know, since Tudor times.[261] We have seen that they managed pragmatically, by trial and error, and by 'buying-in' expertise from private enterprise and the numerous entrepreneurial innovative engineers who flourished in Britain during the middle years of the nineteenth century. Technical change, when it occurred, was therefore of an empirical nature. We have also observed the close control which the Admiralty continued to exercise during this period, thus maintaining the detailed direction the Navy Board had traditionally applied to all Dockyard operations. A remarkable variety of fittings and instrumentation followed one upon the other with some rapidity in this short period. They led to new appointments, new buildings, and a new lease of life for the Dockyard which had languished since the Treaty of Vienna, 1814/15. They brought it to the eve of the Crimean War, when the yard was again put to the test, preparing ships for the campaign, and, looking further ahead, to the era of the ironclad, in the 1860s.

H.M.S. RIFLEMAN, *Portsmouth Dockyard's first screw steamer, launched 10 August 1846*
Drawing by Hugh Launder in the author's possession

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13 *Ibid.*, p. 11.
14 *Ibid.*, p. 4.
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16 1841 Census, Portsea: residing at 4, Cumberland Place (born in the county).
17 POR/M/1B.
18 *Ibid.*, 22 Oct. 1833.
19 *(N)avy (L)ist*, 1834. The prefix 'H.M.S.' has been dropped in this Paper, it being understood that all vessels mentioned are H.M. Ships, unless otherwise stated. It should be borne in mind that although the present-day convention of rendering ships' names in italics in the text has been followed, where quotations occur, the form used in the original document has not been altered.
20 POR/M/1B, *passim*.
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22 J. J. Colledge, *Ships of the Royal Navy: an historical index*, (2 vols.), Newton Abbot (1969 & 1970), I, p. 280.
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26 Colledge, *op. cit.*, I, p. 264.
27 POR/M/2, 26 June 1835.
28 POR/M/3 'Light' i.e. with guns, without stores.
29 *HT* 26 Dec. 1836, p. 4.
30 POR/M/3, 20 Jan. 1837.
31 Eng. Captain E. C. Smith *A Short History of Naval and Marine Engineering*, Cambridge (1937), p. 128.
32 First Secretary at the Admiralty 27 Apr. 1835–4 Oct. 1839: Sainty, *op. cit.*, p. 158
33 E. C. Smith., *op. cit.*, pp. 127–128. John Seaward (1786–1858) and his brother, Samuel (1800–41) were engine builders at Millwall, *D N B*, XVII, p. 1106. Cimisic was 'a form of resin', according to *The Oxford English Dictionary*.
34 POR/M/3, 5 April 1837: Maitland to the Secretary of the Admiralty.
35 *Ibid.*
36 *Ibid.*
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39 *Ibid.*
40 'The first engineers to enter the Navy were mechanics, often supplied by the firms which had built the ships' engines . . . the first Engineers . . . included no commissioned or warrant ranks'. N. A. M. Rodger *Naval Records for Genealogists*, (P)ublic (R)ecord (O)ffice, (1984), p. 25. See also therein the table starting on p. 26, tracing the evolution of the Engineering branch, beginning in 1837.
41 The wages of a 3rd. Engineer in *N L*, Jan. 1839, p. 167, (they are not shown for 1837 or 1838) were '5l 6s per lunar month'. The cost of the damage was therefore equivalent to six months' pay for a 3rd. Engineer.
42 E. C. Smith, *op. cit.*, p. 341.
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44 W. L. Clowes *et al.*, The *Royal Navy: a history* . . ., (7 vols.), (1897–1903), VI, p. 185.
45 POR/P/1, 28 Aug. 1840.
46 *Ibid.*
47 G. Penn, "*Up Funnel, Down Screw*", (1955), p. 54.
48 Johnathan Downton (fl. ?1825–c.1838), a former shipwright, must have died pre-1839, as his widow brought a petition that year to extend his patent for water-closets in ships (No. 5187). Information kindly supplied by the British Library, Science Reference Library, in letter of 14 Sept. 1982, ref. BM/EL.
49 The pump was patented in 1825 (No. 5221). Source as Ref. 48.
50 POR/P/2, 14 Oct. 1840.
51 POR/P/2.
52 'Job and Task' were forms of piece-work used in the Dockyard. New work was referred to as 'task' and repairs as 'job-work'. Otherwise, men were employed by the day, on 'day-work'. See Roger Morriss, *The Royal Dockyards during the Revolutionary and Napoleonic Wars* Leicester (1983), pp. 25 and 30.
53 Author's emphasis.
54 Repair work. The ship was launched at Plymouth in 1815.
55 POR/P/3.
56 *Ibid.*
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60 'Cleets' or 'Cleats': wooden fittings for fastening ropes upon.
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64 POR/P/3.
65 POR/P/6.
66 W. L. Clowes, *op. cit.*, VI, p. 310. British ships took part in an international operation to assist Turkey, which country was faced with a revolt in its Egyptian province and a move north by the rebel forces.
67 '. . . the next class of vessel to a ship of the line . . .': W. H. Smyth *The Sailor's Word-Book* . . . (1867), p. 325.
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$$\frac{\text{Length} - 3/5\ \text{Max. beam} \times \text{Max. beam} \times \tfrac{1}{2}\ \text{Max. beam}}{94}$$

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71 POR/P/7.

72 Information by courtesy of the Archivist, Glasgow University, 20 Aug. 1982.

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80 POR/P/10.

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83 *Ibid.*, 12 Jan. 1842.

84 *Ibid.*, 14 Jan. 1842.

85 POR/P/10.

86 *Ibid.*

87 Ships in reserve.

88 POR/P/10.

89 *Ibid.* 'Guardship': 'A vessel of war appointed to superintend marine affairs in a harbour . . .': Smyth, *op. cit.*, p. 353.

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93 POR/P/12.

94 Colledge, *op. cit.*, I, p. 209.

95 (1790–1870) Captain of *Excellent* (gunnery school) 1832–1845, and jointly Superintendent of the RN College, 1839–1845: *D N B*, IX, p. 136.

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105 *Ibid.*

106 *Ibid.*

107 The Programme occupied eight backed (except two) foolscap sheets.

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110 *Ibid.*

111 John Ericsson (1803–1889) was a Swedish-American inventor. He designed the revolutionary USS *Monitor*: N M M *Cat. Biog.*, II, p. 641.

112 E. C. Smith, *op. cit.*, p. 67.

113 Cf. The Science Museum, London, slide No. 21746 illustrating 28 varieties of 'Submerged Screw Propellor' available as at 1850.

114 The 'Principal Officers' comprised the heads of departments, i.e. Master Attendant, Master Shipwright, Storekeeper, Chaplain, Surgeon, etc.: cf. *N L*'s of the period.

115 Probably amongst the Master Shipwright's subordinates.

116 POR/P/17, 17 Aug. 1844.

117 p. 4.

118 POR/P/17.

119 *Ibid.*

120 POR/P/20.

121 *Ibid.*, 25 Sep. 1844.

122 The merchant vessel *Cambrian* had arrived with a cargo of African timber.

123 POR/P/18.

124 *Ibid.*

125 E. P. Halsted, Capt. RN, (fl. c.1821–1851), in *The Screw Fleet of the Navy* (1850), p. 53.

126 *Ibid.*

127 W. M. Petty 'The Introduction of the Screw-Propellor into the Navy, 1830–1860', unpubl. M.Phil thesis, London University (1969), pp. 152–4 refer to problems with some of the Portsmouth built ships. See also D. K. Brown, n. 143, below.

128 4 Jan 1845, p. 4.

129 'Ironmaster': information kindly supplied by the Inst. of Civ. Eng., 25 Oct. 1982.

130 POR/P/19.

131 Master Shipwright: cf. contemporary *N L*'s.

132 POR/P/19.

133 *Ibid.*

134 *Ibid.*

135 *Ibid.*

136 See, for example, POR/P/20, July 1845 onward.

137 POR/P/20, 3 July 1845.

138 p. 4.

139 *Ibid.*

140 *Ibid.* The report contains names of some contemporary property holders, businesses, and their counsel.

141 C. I. Hamilton 'The Royal Navy Sea Power and the screw ship of the line 1845–60', (unpubl. Ph.D. thesis, Cambridge University 1974).

142 *Ibid.*, p. 15.

143 See also D. K. Brown, 'The First Steam Battleships', *The Mariner's Mirror*, 63, 4, (Nov. 1977), pp. 327–333.

144 *Edinburgh* was converted there in 1846: Colledge, *op. cit.*, I, p. 183.

145 POR/P/20, 25 July 1845.

146 Colledge, *op. cit.*, I, p. 495.

147 POR/P/21, 18 Aug. 1845.

148 Colledge, *op. cit.*, I, p. 504.

149 This theme recurs throughout the period: e.g. *Rattler* v. *Alecto* (paddle v. screw trial); construction of *Odin* (paddle) v. *Dauntless* (screw) frigates.

150 Chief Asst. and Draughtsman to the Surveyors (1839–48); W. L. Clowes, *op cit.*, VI, p. 186.

151 i.e. 'The dimensions of a timber when reduced to its standard size'. Smyth: *op. cit*, p. 595.

152 POR/P/21.

153 Jos. Miller (1797–1860) and John R. Ravenhill (1824–1894): F. Boase *Modern Eng. Biog.*, (6 vols. 1965, reprint), I & II.

154 POR/P/21.

155 *Ibid.*

156 *Ibid.*

157 *Ibid.*

158 *Ibid.*

159 Hamilton Ellis *British Railway History*, (2 vols.), (1960), I, pp. 162–175.

160 —— *Four Main Lines* (1950), pp. 172–3.

161 POR/P/21.

162 P R O (Kew): abstract in IND 12252–97a–1, p. 17.

163 POR/P/22, 15. Oct. 1845.

[164] Thos. Lloyd (1803–75), formerly of Portsmouth Dockyard, then at Woolwich: Penn *op. cit.*, p. 29, and N M M *Cat. Biog.*, II, p. 760.
[165] Andrew Murray (1813–72), Asst.Chief Engineer at Woolwich Dockyard, 1843. In 1846 to be appointed to Portsmouth: Boase, *op. cit.*, II, p. 1040.
[166] POR/P/22.
[167] (1775–1858) C.-in-C. at Portsmouth 1845–48: *D N B* XIV, p. 930.
[168] POR/P/23.
[169] Presumably Taplin, though this is the first use of the title found.
[170] POR/P/23.
[171] Commander Wm. Crispin is recorded in *N L* 1850 as serving in *Victoria and Albert*, Steam Yacht.
[172] J. & W. Rannie, Engineers, St. George's Sq., Portsea: *P.O. Hampshire Trades Directory* (1847).
[173] Regarding which, see R. C. Riley, *op. cit.*, pp. 10–11.
[174] POR/P/23, 21 Nov. 1845.
[175] *Ibid.*, 26 Nov. 1845.
[176] John Penn (1805–1878), 'patented a method of lining the sea-bearings of screw-propellors with *lignum-vitae* in 1854' (Pat. No. 2114): *D N B*, XV, p. 750.
[177] POR/P/24.
[178] See Science Museum, London, *Descriptive Catalogue*, II, *Marine Engines*, (1938), pp. 77–8, for details of 'Taplin's Telescopic Funnel' of 1848, from models in the collection.
[179] 'Block-ships': cf. D. K. Brown, 'The First Steam Battleships', *loc. cit.*, p. 330. The vessels were being converted at Portsmouth.
[180] POR/P/25.
[181] POR/P/26.
[182] Word caught in binding of POR/P/26.
[183] POR/P/26.
[184] (c. 1785–1859): Boase, *op. cit.*, I, p. 1046.
[185] POR/P/26.
[186] '. . . a temporary deck laid in any part of a ship, the beams across which it is laid being known as the skid beams.' Kemp, *op. cit.*, p. 820.
[187] POR/P/26, 24 Mar. 1846.
[188] POR/P/26, 9 Feb. and 21 Mar. 1846.
[189] POR/P/26.
[190] POR/P/27.
[191] *Ibid.*
[192] See n. 165, above.
[193] cf. his biography in Boase, *op. cit.*, II.
[194] Observe the note of caution.
[195] POR/P/28, 16 May 1846.
[196] POR/P/28. They comprised five foolscap pages.
[197] POR/P/28.
[198] *Termagant* was then building at Deptford: Colledge, *op. cit.*, I, p. 553.
[199] POR/P/29.
[200] *Ibid.* 1 Oct. 1846. *Cyclops*, paddle frigate, was built at Pembroke in 1839: Colledge, *op. cit.*, I, p. 148.
[201] Word missing in original.
[202] POR/P/30, 4 Nov. 1846.
[203] *Ibid.*, 27 Nov. 1846.
[204] Francis Pettit Smith (1808–1847) *D N B,* XVIII p. 442.
[205] *Royal Frederick* and *Prince Regent*: POR/P/31, 16 Dec. 1846.
[206] POR/P/31.
[207] 9 Jan 1847, p. 4.
[208] POR/P/33.
[209] *Ibid.*
[210] L. T. C. Rolt, *Victorian Engineering* (1970) especially Chapter 6, 'High Noon in Hyde Park', pp. 148–177.
[211] Sir Wm. Fairbairn (1789–1874), engineer: Andrew Murray's former master, and later, partner.
[212] i.e. '. . . an enclosed space below water-level with means of flooding with, or pumping out, water': Kemp, *op. cit.*, p. 130. The caissons closed off the basin from tidal movements. See *Discovery of the Steam Basin Caisson*, The Portsmouth Royal Dockyard Hist. Soc. Publication No. 2, n.d. [1984], on the excavation carried out in January 1984, when the caisson was un-earthed. (Drgs., illusts., map, diags., etc.)
[213] POR/P/33.
[214] Capt. Alexander Ellice R.N.: W. L. Clowes, *op. cit.*, VI, p. 188.
[215] POR/P/33.
[216] Word missing in original.
[217] POR/P/33.
[218] Presumably Francis Pettit Smith: see n. 204.
[219] POR/P/34, 6 May 1847.
[220] *Rifleman*'s iron sister being built by Ditchburn & Mare, at Blackwall: Colledge, *op. cit.*, I, p. 504, and n. 148, above.
[221] POR/P/34.
[222] *Ibid.*
[223] i.e. 'A strong iron frame supporting the paddle shaft': *O.E.D.*
[224] Launched at Portsmouth on 8 Nov 1844: n. 146, above.
[225] POR/P/35.
[226] *Ibid.* 4 June 1847.
[227] *Ibid.* 11 June 1847.
[228] P R O (Kew), IND 12284–91–1, p. 49, 30 Aug. 1847.
[229] Laing, *loc. cit.*, p. 338.
[230] POR/P/37, 14 Sept. 1847.
[231] POR/P/38.
[232] *Ibid.* The dimensions of the screw were given as: 'Diameter 9 ft.; 9 ft. pitch, length . . . eighteen inches'.
[233] POR/P/38, 7 Oct. 1847.
[234] R. C. Riley, *op. cit.*, pp. 8–9.
[235] Headline in *H T*, 27 May 1848, p. 5, above a detailed account of the event.
[236] POR/P/41.
[237] Alexr. Milne (1806–1896), Fourth Naval Lord 23 Dec. 1847–2 Mar. 1852, Sainty, *op. cit.*, p. 140 and *D N B*: XXII, p. 1048.
[238] Sir Baldwin Wake Walker (1802–1876) held this post from 5 Feb 1848 to 1860 when the title was changed to Controller of the Navy: *Cat. Biog.*, N M M, II, p. 497 and W. L. Clowes, *op. cit.*, VI, p. 186.
[239] POR/P/48, 11 Dec. 1848. Geo. Fredk. Muntz (1794–1857) 'managed his father's works . . . in Birmingham . . . He made a large fortune by the manufacture of what is known as Muntz metal patented by him in 1832': Boase, *op. cit.*, II, p. 1031. The substance is described in *D N B* XXXIX, p. 314 as '. . . a compound metal capable of being forged [when red hot or cold] . . . more fit for . . . ships than any metals heretofore used . . . for . . . [that purpose]'.
[240] POR/P/43, 11 Dec. 1848.
[241] POR/P/44.
[242] *Ibid.*
[243] Oakum: '. . . principally used in caulking the seams, for stopping leaks . . .'. It was 'the state into which old ropes are reduced when they are untwisted and picked to pieces': Smyth, *op. cit.*, p. 502.
[244] POR/P/44.
[245] *Ibid.*
[246] POR/P/44, 5 Feb. 1849.
[247] *Ibid.*, 9 Feb. 1849.
[248] Colledge, *op. cit.*, I, p. 154.

249 POR/P/45.
250 See n. 248.
251 Colledge, *op. cit.*, I, p. 223.
252 POR/P/45, 23 Mar. 1850.
253 Water-tube boilers were introduced in 1843: E. C. Smith, *op. cit.*, p. 133.
254 POR/P/45.
255 POR/P/51.
256 The prefix 'Acting' had been dropped.
257 cf. Penn, *op. cit*, *passim*, e.g. Chap. X.
258 Phyllis Deane, *The First Industrial Revolution*, Cambridge (1967), p. 273.
259 List of Ships 'Portsmouth Built' (ref. L A B), courtesy of the Archivist, Royal Naval Museum, Portsmouth.
260 'Carvel-built: a vessel the planks of which are all flush and smooth, the edges being laid close to each other and caulked to make them water-tight': Smyth, *op. cit.*, p. 168.
261 cf. the remains of the *Mary Rose*.

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ACKNOWLEDGEMENTS

I would like to thank Dr. E. A. Course, of Southampton University, General Editor of *The Portsmouth Papers*, for advice, encouragement and guidance, and for his helpful comments on the draft. Dr. R. C. Riley and Dr. J. H. Thomas of Portsmouth Polytechnic also read the draft and made useful constructive suggestions. A. J. Marsh, M.A. studied my initial effort with care and made practical recommendations. To all of these gentlemen I offer my thanks for giving of their time and expertise so generously. For blemishes that remain, I alone am responsible.

I would also like to thank The Director, and staff of the Reading Room, of the National Maritime Museum at Greenwich for research facilities accorded in such congenial circumstances.

Finally, I thank my friend Hugh Lauder for presenting me with his drawing of *Rifleman* (1846), Portsmouth Dockyard's first screw 'war steamer'.

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